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DEVELOPMENT, DISTRIBUTION, AND COMPARISON OF RUDDER FISHES *Kyphosus sectatrix* (Linnaeus) and *K. incisor* (Cuvier) IN THE WESTERN NORTH ATLANTIC

BY DONALD MOORE

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ABSTRACT

Synonymies are listed for *Kyphosus sectatrix* and *Kyphosus incisor*, the two species studied. Development of these species is described and illustrated from the smallest juvenile to the largest adult examined (*K. sectatrix*, 115 specimens from 10.4 to 260 millimeters, standard length; and *K. incisor*, 99 specimens ranging 8.5–252 mm.). All specimens examined were from the North Atlantic Ocean, and most were from the Atlantic coast of the United States and the Bahama Islands north of lat. 23°30′ N. No abrupt changes in rate of development of selected characters occurred with increase of size. However, a gradual decrease in rate of development with increase in size was indicated in many of the characters.

The reported distribution of both species along the Atlantic coast of the United States and the northern Bahamas is reviewed and revised, with the northern reported range for *K. incisor* extended to Cape Cod. Lenth-frequency data indicate an extended spawning season for both species. Scale and pectoral fin-ray counts indicate that few specimens taken in the Gulf Stream came from the northern Bahamas.

The two species are similar except for total dorsal and anal soft-ray counts and gill-raker counts. Scale and pectoral-ray counts indicate that the *K. sectatrix* taken at Bermuda and in the northern Bahamas are not part of the population found along the Atlantic coast of the United States. A key is provided to aid in separating the two species.

DEVELOPMENT, DISTRIBUTION, AND COMPARISON OF RUDDER FISHES *Kyphosus sectatrix* (Linnaeus) and *K. incisor* (Cuvier) IN THE WESTERN NORTH ATLANTIC

By DONALD MOORE, *Fishery Research Biologist*,

Bureau of Commercial Fisheries

Between January 1953 and December 1954 the U.S. Fish and Wildlife Service, in cooperation with the U.S. Navy Hydrographic Office, the Office of Naval Research, the Georgia Game and Fish Commission, and the Florida State Board of Conservation (through the Marine Laboratory, University of Miami), collected data and samples along the south Atlantic coast of the United States and in the northern Bahama Islands on nine cruises of the motorship *Theodore N. Gill* (Anderson, Gehringer, and Cohen, 1956 a, b; and Anderson and Gehringer, 1957 a, b; 1958 a, b; 1959 a, b, c). During identification of the specimens collected by dipnet on these cruises, it became apparent that the juveniles of the two species of the genus *Kyphosus* (family Kyphosidae) reported from the North Atlantic Ocean were, in many instances, not readily distinguishable from one another.

Meek and Hildebrand (1925) in their report on the *Kyphosus* in Panama said,

> * * * The affinities of the Atlantic coast species are, however, not well understood and we cannot be certain of the identification of the specimens at hand. We have compared our specimens with others from North Carolina, Florida, Bermuda, and Cuba. Unless there is much variation among individuals with respect to the depth of body, number of anal and dorsal rays, and number of scales in a lateral series, there must occur on the Atlantic coast more than two species of this genus, the number recognized in current works. * * * A close study of a large amount of material from the Atlantic would be very desirable.

Later publications do not clarify the identification of the species of *Kyphosus* in the North Atlantic; also the development of young of these species has not previously been described.

This paper presents a review of the taxonomy and the results of a study on the development, distribution, and comparison of the two species of rudder fishes, *Kyphosus sectatrix* (Linnaeus) and *Kyphosus incisor* (Cuvier), found along the Atlantic coast of the United States and the northern Bahamas.

Young rudder fishes are available as forage for other fish, and adults are considered to be excellent game and food fish. Mowbray (1949) said of *K. sectatrix*: "Probably the most potentially important small game fish of Bermuda waters is the chub, or rudder fish as it is sometimes known. This fish is found in large numbers amongst the reefs surrounding the island and it rivals the bonefish in gameness, and surpasses it in strength. The average weight of a chub is about eight pounds though they reach twenty."

I am grateful for the assistance given by various staff members and to those who loaned me specimens: Leonard P. Schultz, U.S. National Museum; E. Milby Burton, Charleston Museum; University of Florida Museum; and David K. Caldwell, Brunswick, Georgia; and for information given by Paulo de Miranda Ribeiro.

METHODS AND DEFINITIONS

Measurements of 15 mm. or greater were made with drafting dividers and a Paragon scale; those measurements greater than 50 mm. were recorded to the nearest 0.5 mm. while those from 15 mm. to 50 mm. were recorded to the nearest 0.1 mm. Measurements less than 15 mm. were made with a micrometer eyepiece on a stereoscopic microscope, and recorded to the nearest 0.1 mm. Drawings of fishes, and of caudal osteology, were made with the aid of a camera lucida.

Original measurements were used in the plots of body proportions to standard length. Unless otherwise stated, specimen lengths are standard length measurements. Stained specimens were prepared using the methods described by Hollister (1934) and Evans (1948).

NOTE:—Approved for publication May 24, 1961. Fishery Bulletin 196.

DEFINITIONS OF TERMS

Standard length.—Distance from tip of snout to posterior border of hypural bones. (All measurements from tip of snout are with mouth closed and do not include any anterior protrusion of incisor teeth in adults.)

Eye diameter.—Horizontal width of the orbit.

Head length.—Distance from tip of snout to posterior fleshy margin of opercle.

Body depth at pelvic fin.—Distance from base of pelvic spine to base of first dorsal spine.

Snout to dorsal fin.—Distance from tip of snout to base of first dorsal spine.

Snout to anal fin.—Distance from tip of snout to base of first anal spine.

Snout to pectoral fin.—Distance from tip of snout to insertion of first pectoral ray.

Snout to pelvic fin.—Distance from tip of snout to base of pelvic spine.

Pectoral fin length.—Distance from insertion of first pectoral ray to tip of fin with fin pressed to side of specimen.

Spine.—A fin ray which is relatively inflexible, is unsegmented or becomes unsegmented during development and does not have flattened tip. (Counts are listed by roman numerals.)

Soft-ray.—A fin ray which is relatively flexible, is segmented or becomes segmented during development and usually has a flattened or branched tip. (In caudal fin the counts are listed: dorsal plus ventral.)

Teeth.—Counts given are for one side of one jaw.

Gill rakers.—(1) Entire first arch—total number, including tubercles, on the first gill arch on one side. (2) Upper limb—total on epibranchial bone in first arch excluding raker at angle. (3) Lower limb—total on ceratobranchial and basibranchial bones in first arch including raker at angle. (4) Ceratobranchial bone—total on bone in first arch including raker at angle and any others partly attached to this bone (frequently one raker at junction of the ceratobranchial and basibranchial bones is only partly attached to the ceratobrancial).

Scales.—(1) Row above lateral line—counted in the row above the lateral line, to base of caudal rays. (2) Straight line—counted along the continuous horizontal row which terminates one row below the lateral line at the caudal peduncle, small scales at cleithrum excluded.

Atlantic coast of the United States.—Along the Atlantic coast from Eastport, Maine, to Dry Tortugas Islands, Florida, including the Florida Current to the Bahama Islands.

Northern Bahamas.—The Bahama Islands lying north of Latitude 23°30′ North.

MATERIAL

Measurements and counts of selected parts were recorded from 115 specimens of *Kyphosus sectatrix* ranging from 10.4 to 260 mm. (table 1), and from 99 specimens of *Kyphosus incisor* ranging from 8.5 to 252 mm. (table 2). The specimens of *Kyphosus* at the Biological Laboratory, Brunswick, Ga., ranging from 8.7 to 54.5 mm., w supplemented by material ranging from 8.5 260 mm. from the U.S. National Museum, Charleston Museum, the University of Flori Collections, and the Jamaica collection of Da K. Caldwell.

KYPHOSUS SECTATRIX (LINNAEUS)

Perca saltatrix Linnaeus, 1758: p. 293 (Baham Florida, or Carolina), misprint for *sectatrix* in Cates 1743: p. 8.

Perca sectatrix Linnaeus, 1766: p. 486 (Bahamas, Flor or Carolina), correction of misprint.

Chaetodon cyprinaceus (Broussonet) Gmelin, 17 p. 1269 (tropical Atlantic).

Pimelepterus bosquii Lacépède, 1803: p. 429, pl. I fig. 1 (South Carolina).

Pimelepterus boscii Cuvier in Cuvier and Valencienn 1831: p. 258, pl. CLXXXVII (Carolina).

Pimelepterus oblongior Cuvier in Cuvier and Valen ennes, 1831: p. 264 (locality unknown).

Pimelepterus boscii var. *sicula* Doderlein, 1884: p. (Gulf of Palermo).

Cyphosus bosqui Jordan, 1884: p. 128 (Key We Florida).

Cyphosus elegans (*non* Peters) Metzelaar, 1919: p. (Curacao, Venezuela).

Kyphosus palpebrosus Miranda Ribeiro, 1919: p. 1 (Isle of Trindade, Brazil).

Kyphosus metzelaari Jordan and Evermann, 1927: p. 5 (Curacao, Venezuela).

Kyphosus incisor (*non* Cuvier) Parr, 1930: p. 66 (Tur Island, British West Indies).

Kyphosus incisor (non Cuvier) Fowler, 1944: p. (Roncador Bank, Colombia; off coast of Nicaragua).

Kyphosus lutescens (non Jordan and Gilbert) Carvalh 1950: p. 116 (Isle of Trindade, Brazil).

Kyphosus sectator Tortonese, 1954: p. 82 (Palerm Sicily).

The nomenclature of *Kyphosus sectatrix* (Li naeus, 1766) has been decisive since Jordan a Gilbert (1883) noted that Lacépède had used t name *Kyphosus* for *Kyphosus bigibbus* (180 earlier than *Pimelepterus*. Jordan and Gilbe (1883) also said: "The word should however spelled with an initial C, as *Cyphosus*." Ma subsequent authors made this change. Lacépè did not spell it with a "C," therefore, the corre name is *Kyphosus*.

The species *K. palpebrosus* Miranda Ribei (1919), taken at the Isle of Trindade, Brazil, placed in synonymy with this species since t description of the type differs only slightly fro the description of *K. sectatrix*. Measuremen of selected parts of the 250-mm. holotype, take

TABLE 1.—*Locations and dates of capture of 115 specimens of* Kyphosus sectatrix

[BLBG) U.S. Bureau of Commercial Fisheries Biological Laboratory, Brunswick, Ga. (USNM) U.S. National Museum; (UF) University of Florida; (ChM) Charleston Museum]

Location	Date captured	Collection	Number of specimens	Size (mm.)
TLANTIC COAST OF U.S. AND NORTHERN BAHAMAS:				
23°40′ N., 77°00′ W	Nov. 11–12, 1954	BLBG, *Gill* 9, Tongue of the Ocean	1	26.9
24°28′ N., 77°28′ W	Oct. 8, 1953	BLBG, *Gill* 4, Tongue of the Ocean	2	10.5
24°30′43″ N., 76°23′45″ W	Mar. 13, 1886	USNM 114775	3	19.4–34.0
Tortugas, Fla		USNM 116955	1	115.0
Do		USNM 116963	3	157.5–260.0
Nassau, Bahamas	Apr. 23, 1886	USNM 38433, *Albatross*	3	172.5–215.5
Angel Fish Creek, Fla. (South of Elliots Key)	December 1905	USNM 53302	1	125.0
Broad Creek, Fla. (South of Elliots Key)	Nov. 24, 1906	USNM 57173	1	211.0
Do	Dec. 15, 1905	USNM 53392	1	99.5
25°32′ N., 76°13′ W	Jan. 28, 1954	BLBG, *Gill* 5, Office of Naval Research	2	10.4, 36.2
26°20′ N., 76°43′ W	Jan. 24, 1954	BLBG, *Gill* 5, Std	1	12.0
26°21′ N., 76°44′ W	Jan. 23, 1954	do	1	26.4
26°23′ N., 76°46′ W	June 13, 1954	BLBG, *Gill* 7, Std	1	34.7
Key West, Fla		USNM 38729, *Albatross*	1	45.7
26°54′ N., 79°07′ W	Aug. 29, 1954	BLBG, *Gill* 8, Settlement Point, Bahamas	1	15.4
Jupiter Inlet, Fla	October 1958	UF 5950	1	22.5
27°37′ N., 79°40′ W	Oct. 12, 1953	BLBG, *Gill* 4, Reg. 6	1	15.0
27°38′ N., 76°23′24″ W	Feb. 24, 1886	USNM 114776	2	20.0, 30.8
29°00′ N., 79°48′ W	Oct. 14, 1953	BLBG, *Gill* 4, Reg. 15	1	13.1
Do	Apr. 27, 1954	BLBG, *Gill* 6, Reg. 15	1	11.3
29°10′ N., 80°19′ W	June 1, 1957	BLBG, *Combat* 336	2	18.7, 21.5
29°36′ N., 79°58′ W	Oct. 14, 1953	BLBG, *Gill* 4, Reg. 18	1	18.4
29°40′ N., 80°00′ W	Sept. 13, 1954	BLBG, *Gill* 8, Reg. 18	1	33.3
31°13′ N., 74°41′ W	June 13, 1903	USNM 53138	1	104.5
31°28′ N., 78°42′ W	Oct. 24–25, 1953	BLBG, *Gill* 4, Reg. 40	1	28.5
32°15′ N., 79°49′ W	Oct. 26, 1959	BLBG, *Silver Fay* 1388	1	52.0
32°18′ N., 77°29′ W	Oct. 26, 1953	BLBG, *Gill* 4, Reg. 51	1	26.8
32°24′ N., 79°28′ W	Oct. 26, 1959	BLBG, *Silver Fay* 1390	1	44.0
Charleston, S.C. (Pilot ship)	Sept. 18, 1938	ChM 38.210.2	4	39.6–71.6
Charleston, S.C	Sept. 4, 1938	ChM 38.207.5	2	36.1, 77.6
Magnolia Beach, S.C	September 1934	ChM 34.302.2	47	33.9–55.1
33°44′ N., 76°56′ W	Sept. 28, 1954	BLBG, *Gill* 8, Reg. 65	1	12.7
34°34′ N., 74°55′ W	Sept. 29, 1954	BLBG, *Gill* 8, Reg. 80	2	11.3, 13.2
Fort Macon Inlet, Beaufort, N.C	July 27, 1916	USNM 11752	6	25.6–39.6
38°25′ N., 72°40′ W	1885	USNM 101543	1	26.1
Woods Hole, Mass	Aug. 21, 1899	USNM 120580, *Fish Hawk*	1	133.0
ID NORTH ATLANTIC:				
Bermuda	1877	USNM 20177	1	154.5
Do	do	USNM 23543	1	236.0
Do	do	USNM 23544	1	194.0
Do	do	USNM 23545	1	171.0
Do	do	USNM 23546	1	168.0
ARIBBEAN SEA:				
Toro Point, Panama	Apr. 11, 1912	USNM 80668	1	244.0
Kingston, Jamaica, B.W.I. (Fish Market)	Apr. 21, 1959	D. K. Caldwell	1	230.0
Jamaica, B.W.I		USNM 37688	2	219.0, 259.0
Corrientes Bay, Cuba	Apr. 8, 1937	USNM 107431	1	100.5
West Indies	January 1885	USNM 131532	1	46.5
ASTERN NORTH ATLANTIC:				
Madeira		USNM 94528	1	211.0
Terceira, Azores	1894	USNM 94498	1	212.0

y Dr. Paulo de Miranda Ribeiro, August 28, 1959 written communication), fell within the ranges ound for *K. sectatrix*, except the eye diameter hich was 6.8 percent of standard length. In my *K. sectatrix* above 150 mm., eye diameters ranged .5–10.2 percent of standard length.

The description of *K. incisor* by Pārr (1930) has ll the distinguishing features of *K. sectatrix*.

The description of *K. incisor* by Fowler (1944), hich was later changed to *K. palpebrosus* by owler (1953), also has all the distinguishing eatures of *K. sectatrix*, including eye diameter.

The description of the specimen identified as *K. lutescens* by Carvalho (1950) from the Isle of rindade, Brazil, is the same as that found for *K. sectatrix* except for the color and the number f scales. I found the color of *K. sectatrix* to be ariable. Carvalho (1950) listed 98–101 scales, a count higher than that given for the holotype of *K. lutescens* by Jordan and Gilbert (1881) or for either *K. lutescens* or *K. sectatrix* by Jordan and Evermann (1898) [whom Carvalho (1950) used for comparisons]. Carvalho (1950) did not indicate the location of scales counted. I have not examined the relationship of the Pacific species *K. lutescens* with *K. sectatrix*.

The record of *K. sectator* Tortonese (1954) is of the same specimen named *Pimelepterus boscii* var. *sicula* by Doderlein (1884) which is placed in synonymy.

DEVELOPMENT

Dorsal fin.—X (6 specimens) or XI (54 specimens)—11 (4 specimens), 12 (100 specimens), or 13 (5 specimens) (table 3). Full complement of total dorsal rays (spines and soft-rays combined) is present by 10.4 mm. (see fig. 1, 10.5 mm.).

TABLE 2.—*Locations and dates of capture of 99 specimens of* Kyphosus incisor

[(BLBG) U.S. Bureau of Commercial Fisheries Biological Laboratory, Brunswick, Ga. (USNM) U.S. National Museum; (UF) University of Florida; (ChM) Charleston Museum.]

Location	Date captured	Collection	Number of specimens	Size (mm)
ATLANTIC COAST OF U.S. AND NODTHERN BAHAMAS:				
23°40′ N., 77°00′ W	Nov. 11–12, 1954	BLBG, *Gill* 9, Tongue of the Ocean	1	1
24°04′ N., 79°15′ W	July 24, 1957	BLBG, *Combat* 448	4	10. 2–14
Tortugas, Fla		USNM 116956	1	2
Do		USNM 116964	3	184. 5–23
Nassau, Bahamas	Apr. 23, 1886	USNM 38433, *Albatross*	1	25
25°32′ N., 76°13′ W	Jan. 28, 1954	BLBG, *Gill* 5, Office of Naval Research	1	5
26°20′ N., 76°47′ W	June 13–14, 1954	BLBG, *Gill* 7, Std	1	1
26°23′ N., 76°48′ W	July 19, 1953	BLBG, *Gill* 3, Std	1	1
Martello Tower, Key West, Fla	July 3, 1919	USNM 111749	1	2
Cow Key, Key West, Fla	July 15, 1919	USNM 111748	1	2
26°37′ N., 79°51′ W	July 28, 1957	BLBG, *Combat* 458	1	5
26°47′ N., 79°53′ W	do	BLBG, *Combat* 459	1	2
Palm Beach Inlet, Fla	June 9, 1958	UF 5918	1	2
Jupiter Inlet, Fla	July 6, 1958	UF Unsorted	1	1
Do	August 1958	UF 5981	1	1
Do	Dec. 21–24, 1958	UF (uncatalogued)	1	8
27°14′ N., 79°50′ W	July 29, 1957	BLBG, *Combat* 462	1	2
28°35′ N., 79°38′ W	June 10, 1958	BLBG, *Silver Bay* 447	1	1
29°00′ N., 77°00′ W	July 17, 1953	BLBG, *Gill* 3, Spc. 6	1	1
29°00′ N., 79°26′ W	Aug. 14, 1953	BLBG, *Gill* 4, Reg. 16	1	8
29°10′ N., 80°19′ W	June 1, 1957	BLBG, *Combat* 336	3	15. 8–24
29°22′ N., 80°05′ W	Nov. 24, 1957	BLBG, *Silver Bay* 227	1	14
29°29′ N., 80°09′ W	Aug. 18, 1957	BLBG, *Combat* 485	1	3
29°29′ N., 80°10′ W	Aug. 19, 1957	BLBG, *Combat* 490	1	2
29°36′ N., 80°08′ W	Jan. 28, 1960	BLBG, *Silver Bay* 1620	1	21
29°38′ N., 79°36′ W	June 25, 1954	BLBG, *Gill* 7, Reg. 17	2	9. 1, 10
30°58′ N., 79°38′ W	Oct. 16, 1953	BLBG, *Gill* 4, Reg. 30	1	18
31°00′ N., 80°23′ W	do	BLBG, *Gill* 4, Reg. 32	3	16. 7–28
31°00′ N., 80°46′ W	do	BLBG, *Gill* 4, Reg. 33	1	37
St. Simons Island, Ga	Oct. 5, 1955	BLBG	1	44
32°39′ N., 76°46′ W	Aug. 10, 1953	BLBG, *Gill* 3, Reg. 62	1	16
32°40′ N., 79°16′ W	Oct. 24, 1959	BLBG, *Silver Bay* 1372	9	23. 4–31
Charleston, S.C. (Pilot ship)	Sept. 18, 1938	ChM 38.210.2	4	39. 1–45
32°43′ N., 71°51′ W	Jan. 5, 1885	USNM 119766, *Albatross*	1	24
Charleston Harbor, S.C	Oct. 8, 1936	ChM 36.189.1	2	44. 2, 58
Charleston, S.C	Sept. 4, 1938	ChM 38.207.5	3	23. 9–45
33°15′ N., 76°23′ W	May 8, 1953	BLBG, *Gill* 2, Reg. 63	3	13. 6–16
33°29′ N., 76°40′ W	Aug. 11, 1953	BLBG, *Gill* 3, Reg. 64	4	9. 8–14
Magnolia Beach, S.C	September 1934	ChM 34.302.2	4	35. 1–38
Do	October 1934	ChM 34.316.6	1	25
33°44′ N., 76°56′ W	Sept. 28, 1954	BLBG, *Gill* 8, Reg. 65	1	14
33°50′ N., 75°59′ W	July 10, 1954	BLBG, *Gill* 7, Reg. 72	1	18
34°04′ N., 76°14′ W	do	BLBG, *Gill* 7, Reg. 71	1	19
34°09′ N., 75°24′ W	Sept. 26, 1954	BLBG, *Gill* 8, Reg. 73	1	34
34°14′ N., 76°03 W	Sept. 15, 1959	BLBG, *Silver Bay*	2	14. 7, 16
34°34′ N., 74°55′ W	Sept. 29, 1954	BLBG, *Gill* 8, Reg. 80	1	15
34°34′ N., 75°40′ W	July 24, 1960	BLBG, *Silver Bay* 2201	5	10. 3–13
Off Cape Lookout, N.C	Sept. 2, 1914	USNM 111750, *Fish Hawk*	2	14. 5, 17
Fort Macon Beach, Beaufort, N.C	July 27, 1916	USNM 111752	6	29. 8–45
35°08′ N., 75°22′ W	Sept. 24, 1954	BLBG, *Gill* 8, Reg. 78	1	13
35°12′30″ N., 75°05′00″ W	Oct. 19, 1884	USNM 83846, *Albatross*	1	38
38°50′ N., 70°07′ W	Sept. 16, 1886	USNM 85501, *Albatross*	1	23
40°03′30″ N., 67°27′15″ W	July 15, 1885	USNM 133875, *Albatross*	2	30. 8, 38
Woods Hole, Mass		USNM 58932	1	101
WESTERN NORTH ATLANTIC:				
Porto Inhuama, Brazil	May 1935	USNM 100812	1	233

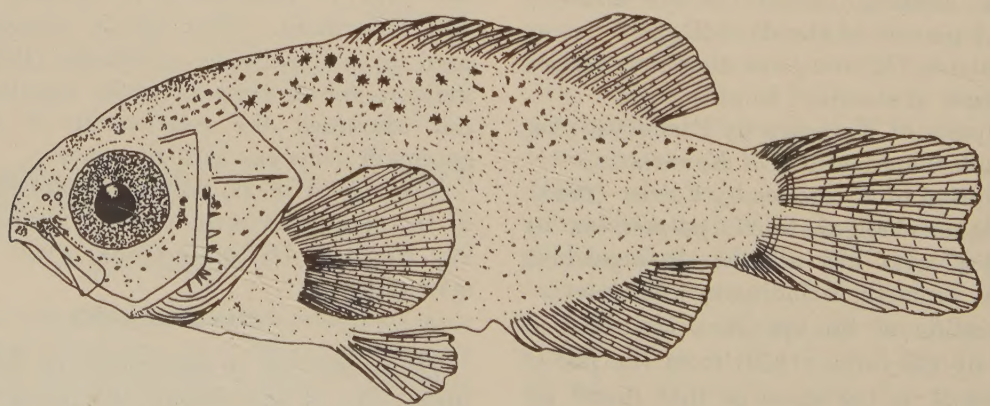

FIGURE 1.—*Kyphosus sectatrix* juvenile, 10.5 mm. (preserved for 7 years).

TABLE 3.—*Number of dorsal and anal soft-rays on 115 specimens of* Kyphosus sectatrix

Number of anal soft-rays	Number of dorsal soft-rays: 11	12	13
9	------	1 (0.9)	------
10	------	------	------
11	4 (3.5)	100 (86.9)	5 (4.3)
12	------	5 (4.3)	------

NOTE.—Open figures denote numbers; figures in parentheses denote percentages of specimens having respective combinations of numbers of soft-rays.

The last spine is pointed but still segmented, indicating near completion of a transition from a segmented ray to an unsegmented spine. Similar development has been noted in anal spines of mullet (Anderson, 1957) and striped bass (Manzueti, 1958). The transition completes the complement of the dorsal spines.

The spines are not inserted in a single mid-dorsal row, but rather alternately to the left and right of the mid-dorsal line. The interspinous membrane is nearly mid-dorsal in position, thus attaching to alternate sides of consecutive spines.

At 10.4 mm., all soft-rays are unbranched, except for the last which is divided to its base, all are segmented and the tips are all flattened. The next to last ray is branched by 13.1 mm., and by 15.4 mm., all but the first three soft-rays are branched (including both elements of the last). By 21.5 mm., all but the first soft-ray are branched, and by 26.4 mm., all soft-rays are branched.

Anal fin.—III (59 specimens) or IV (1 specimen)—9 (1 specimen), 11 (109 specimens), or 12 (5 specimens) (table 3). The full complement of rays is present by 10.4 mm., the soft-rays are segmented with tips flattened and the last ray is branched to its base (see fig. 1, 10.5 mm.). In an 8.7-mm. *K. incisor* the third ray is segmented and pointed, indicating a transition from segmented ray to unsegmented spine. Although I have no *K. sectatrix* that small, I expect the transition to occur in this species also. No additional soft-rays are branched by 13.2 mm. By 15.0 mm., the next to last and the anterior element of the last ray are branched (fig. 2), by 15.4 mm., 10 soft-rays are branched, and by 21.5 mm., all are branched. The first two spines articulate with the same bone in the only specimen having four anal spines.

Pectoral fin.—17 (8 specimens), 18 (77 specimens), or 19 (25 specimens) soft-rays (table 4). The full complement of rays is present by 10.4 mm. (see fig. 1, 10.5 mm.). In a 10.5-mm. cleared and stained specimen all but the first and last rays have flattened tips, all but the first and the last three rays are segmented, and all are unbranched. By 15.4 mm., initial branching has started in eight of the middle rays, and by 26.9 mm., all are segmented, and all but the first two and the last two are branched. By 52 mm., the first two rays and the last ray are still unbranched, though secondary branching has commenced in the 10 middle rays. The last ray is branched by 71.5 mm., but the first two rays remain unbranched to at least 260.0 mm., the largest specimen examined.

Pelvic fin.—I, 5 (53 specimens). Full complement of one spine and five soft-rays is present by 10.4 mm., with all five soft-rays segmented and the middle three branched (see fig. 1, 10.5 mm.). By 13.1 mm., the remaining soft-rays have also branched.

Caudal fin.—9+8 principal rays (50 specimens) and 9+9 secondary rays in a fully formed caudal fin. By 10.5 mm., all the principal rays are formed, with tips flattened (fig. 1), 8+8 secondary rays are present, and the two secondary rays adjacent to the principal rays in both dorsal and ventral lobes are segmented. By 13.1 mm., the principal rays have begun to branch, and by 15.0 mm. (fig. 2), branching is complete (the dorsalmost principal ray and ventralmost principal ray do not branch). The complement of secondary rays is complete (9+9) in a 15.4-mm.

TABLE 4.—*Number of pectoral fin-rays on 110 specimens of* Kyphosus sectatrix *and 71 specimens of* Kyphosus incisor

[Arranged by species and area of capture]

Species	Area of capture	Number of specimens with pectoral fin-rays numbering— 17	18	19	20
Kyphosus sectatrix.	Atlantic coast of United States	8	69	6	------
	Bermuda and northern Bahamas (including Antilles Current and excluding Florida Current).	------	3	16	------
	Caribbean Sea	------	4	2	------
	Eastern Atlantic	------	1	1	------
Kyphosus incisor.	Atlantic coast of United States	------	7	55	5
	Northern Bahamas (including Antilles Current and excluding Florida Current).	------	------	3	------
	Brazil	------	------	------	1

specimen. (The secondary rays were examined in cleared and stained material only.)

Gill rakers.—Entire first arch, 21 to 27; upper limb, 5 to 8; lower limb, 16 to 19; ceratobranchial bone, 11 to 14 (tables 5 and 6). The data indicate a very slight increase in number of gill rakers with increase in size from 10 to 260 mm. The number of rakers on the ceratobranchial bone increases slightly with growth, probably the result of migration of the first rakers from on, or by, the upper end of the basibranchial bone. In many specimens one raker is located virtually at the space between the two bones, and often the last one or two rakers on the ends of the upper or lower limbs are tubercles.

Scales.—Row above lateral line, 60 to 73; straight line, 47 to 64 (table 7). By 10.5 mm., the sides of the body and peduncle have scales, but the head, belly, and dorsal and anal fin bases are bare. By 15.4 mm., parts of the head have scales, the scales extend from the dorsal ends of the opercular flaps, forward to a perpendicular from the anterior edge of the pupil; there are patches of scales ventral and posteroventral to the orbit and on the upper part of the operculum; scales extend onto the bases of the middle principal rays of the caudal fin, and a small area forward of the pectorals and another small area under the proximal part of the pelvics are naked. By 26.4 mm., scales cover the bases of all fins and the head, except for the area around and anterior to the nostrils, the lips, the edge of the orbit, and the preopercular and opercular margins. Scales extend for about two-thirds of the length of the soft dorsal and anal fin rays by 52 mm., but extend out only about one-third on the pectoral and caudal and one-half on the separate rays of the pelvics. At 215.0 mm., the distal third of the pectoral is naked. All

TABLE 5.—*Number of gill rakers on upper and lower limbs of first arch on 103 specimens of* Kyphosus sectatrix *larger than 16 mm.*

Number of upper-limb gill rakers	Number of lower-limb gill rakers: 16	17	18	19
5	------	2 (1.9)	1 (1.0)	------
6	3 (2.9)	40 (38.8)	25 (24.3)	1 (1.0)
7	------	7 (6.8)	20 (19.4)	3 (2.9)
8	------	------	------	1 (1.0)

NOTE.—Open figures denote numbers, and figures in parentheses den percentages of specimens having respective combinations of numbers of rakers.

the fins have scales by 260.0 mm., except t dorsal and anal spines which have scales only the bases and the pelvics which have scales on along the rays.

Teeth.—Dentition of the 10.5-, 15.4-, and t 36.2-mm. specimens was determined by clearin and staining.

A 10.5-mm. specimen had 10 uneven caninifor teeth in a row on each premaxillary, with a fe villiform teeth behind this row, and six uneve caniniform teeth in a row on each dentary, all various degrees of development.

On a 15.4-mm. specimen, there were 15 uneve caniniform teeth in a row on each premaxillar five to nine uneven caniniform teeth on ea dentary, with a few villiform teeth behind the on each jaw, and about two villiform teeth o each half of the vomer.

A 36.2-mm. specimen had 13 teeth in a ro on each premaxillary, of which half were canin form and half were incisor, and 12 teeth in a ro on each dentary, also half of which were caninifor and half incisor. Other teeth were present behi the rows on the premaxillaries. The vomer ar

TABLE 6.—*Variation in number of gill rakers on first arch of* Kyphosus sectatrix

[Specimens grouped by size]

Standard length	Number of specimens with gill rakers on first arch numbering—																			
	Entire arch							Upper limb				Lower limb				Ceratobranchial bone				
	21	22	23	24	25	26	27	5	6	7	8	16	17	18	19	11	12	13	14	
10.5–15.9 mm	1	1	------	------	------	------	------	1	1	------	------	2	------	------	------	------	2	------	------	
16.0–19.9 mm	------	1	2	------	------	------	------	1	2	------	------	------	3	------	------	------	1	1	------	
20.0–29.9 mm	------	1	6	4	------	------	------	1	10	------	------	------	7	4	------	------	4	5	------	
30.0–39.9 mm	------	1	15	10	2	------	------	------	24	4	------	1	18	8	1	------	13	14	------	
40.0–49.9 mm	------	------	15	10	6	------	------	1	23	7	------	------	15	16	------	------	8	23	------	
50.0–149.9 mm	------	2	------	5	3	2	------	------	5	7	------	2	2	6	2	1	1	10	------	
150.0–260.0 mm	------	------	3	3	10	1	1	------	5	12	1	------	4	12	2	------	------	9		

TABLE 7.—*Number of scales along straight line on 104 specimens of* Kyphosus sectatrix *and 54 specimens of* Kyphosus incisor *larger than 18 mm.*

[Arranged by species and area of capture]

Species	Area of capture	Number of specimens with scales along straight line numbering—																	
		47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Kyphosus sectatrix	Atlantic coast of United States	1	2	3	7	22	15	19	6	1	1				1				
	Bermuda and northern Bahamas (including Antilles Current and excluding Florida Current)										1	4		2	2	2	3	1	2
	Caribbean Sea								2	2	2		1						
	Eastern Atlantic										1						1		
Kyphosus incisor	Atlantic coast of United States								3	2	3	6	14	9	7	5	1		
	Northern Bahamas (including Antilles Current and excluding Florida Current)										1		1		1				
	Brazil												1						

tongue each had about 12 villiform teeth (6 on each side), and each pterygoid had about six teeth. The incisor teeth on the jaws had the horizontal base processes found in the adults. The rows of teeth were interspaced with both incisiform and caniniform types.

From about 100 mm., characteristic adult teeth are present. There are about 13 to 22 incisiform teeth in a row on each side of each jaw, with large horizontal basal processes as described by Jordan and Evermann (1898), Evermann and Marsh (1900), and Günther (1859). Villiform teeth are behind these rows. The patches of villiform teeth on the tongue and pterygoid are slightly larger than at smaller sizes, the vomer is still covered with teeth, and there are also some teeth on the palatines.

Pigmentation.—Unless otherwise noted the pigmentation described is on specimens preserved in formalin for 2 to 8 years (up to 55 mm.) and in alcohol for more than 20 years (above 55 mm.). This species has striped and spotted phases which Townsend (1929) found the fish could alternate quickly. Between 10 and 12 mm., small dark pigment spots cover most of the body and the fins, except for the caudal, the region of the first three dorsal and anal soft-rays, and the distal parts of the remainder of the soft dorsal and anal fins (fig. 1). There are larger, lighter brownish spots on the top of the head, upper lip, and before and behind the eye. Several rows of large dark spots are above the lateral line on some, or the dark spots may be more dense and uniform on the body on others. Also, some have faint brownish bands on the sides below the dorsal fin.

Between 12 and 15 mm., the first three dorsal and anal soft-rays have pigment spots, except at the tips (fig. 2). The intensity of pigment on the dorsal, anal, and pelvic fins is greater than on the smaller specimens.

Between 15 and 16 mm., the large brownish spots previously found on the head are absent. Small brownish spots extend along the scale rows and are most prominent above the lateral line. Small dark dashes are found along the pectoral rays. Dark pigment spots extend further out on the dorsal and anal soft-rays, and some spots are found in the middle of the caudal fin near the hypural base.

Between 18 and 19 mm., sides are brownish with light buff-colored patches (fig. 3A). The head is brownish dorsally and buff ventrally. The entire ventral surface back to the anal spine is buff.

Between 20 and 30 mm., the sides are generally buff with light brownish areas with dark stripes along scale rows above the lateral line. Usually the buff spots with brown background are more distinct than the dark stripes on preserved specimens (fig. 3B). Nearly all have pigment around the first three dorsal and anal soft-rays.

Between 30 and 75 mm., the whole body is dark with light patches (fig. 3C, D, and E), including the head, stomach, dorsal and anal fins, and the proximal half of the caudal fin. On specimens preserved about one year the same pattern is present, but the brown portion is gray and the dark parts are darker (fig. 3D).

Between 75 and 260 mm., there are no spots or light patches on the sides; brassy stripes follow along the scale rows of the specimens preserved for more than 20 years (fig. 3F). One 230-mm. specimen from Jamaica, preserved for less than one year, was slate gray on the sides.

Gray is given as the predominant color of adults in some accounts (Evermann and Marsh, 1900;

FIGURE 2.—*Kyphosus sectatrix* juvenile, 15.0 mm. (preserved for 7 years).

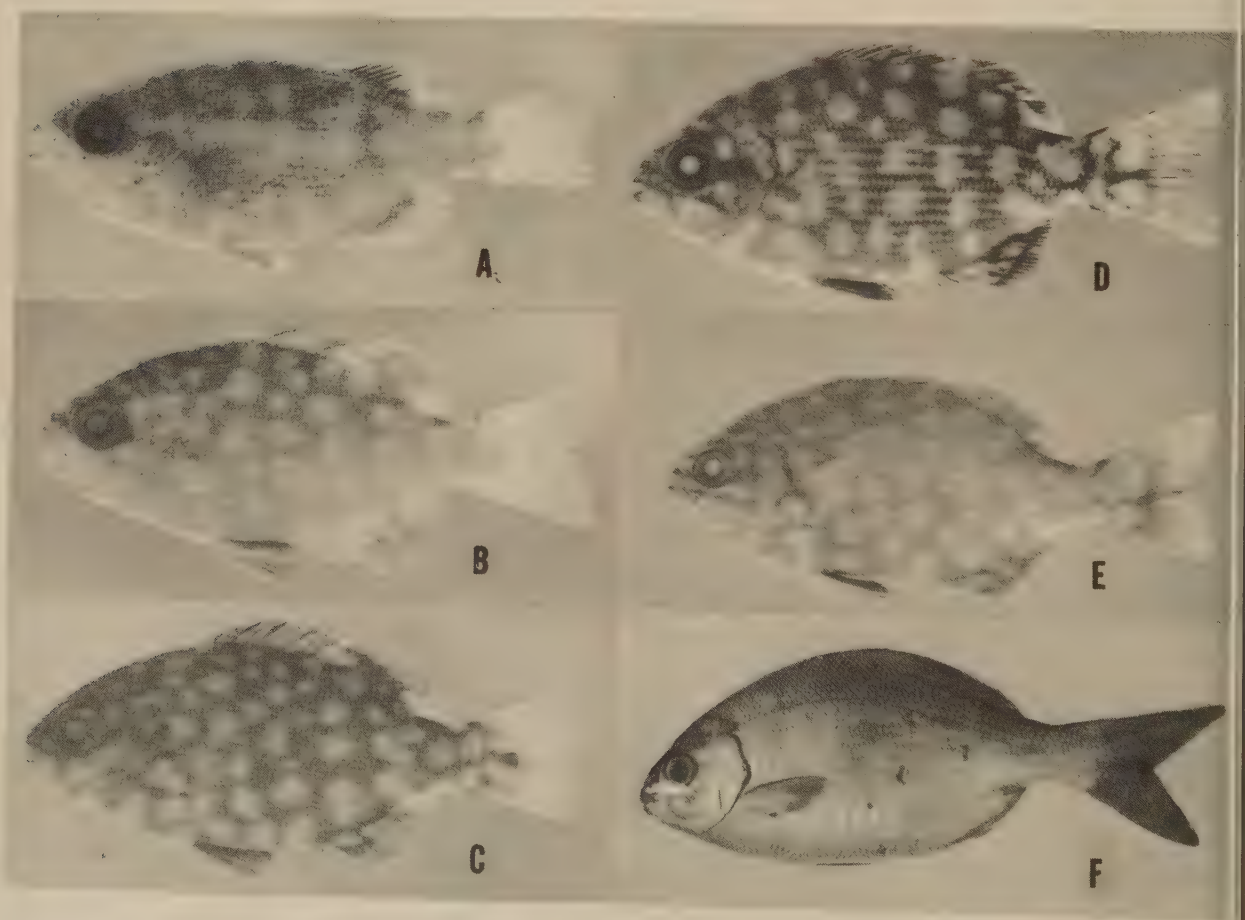

FIGURE 3.—*Kyphosus sectatrix;* A, juvenile, 18.7 mm. (preserved for 3 years); B, juvenile, 28.5 mm. (preserved for
years); C, juvenile, 33.3 mm. (preserved for 6 years); D, juvenile, 52.0 mm. (preserved for 1 year); E, juvenile, 71
mm. (preserved for 22 years); F, adult, 260.0 mm. (preserved for over 25 years).

nd Truitt, Bean, and Fowler, 1929); Longley nd Hildebrand (1941) do not mention gray in neir description of this species.

ISTRIBUTION ALONG THE ATLANTIC COAST OF THE UNITED STATES AND THE NORTHERN BAHAMAS

Kyphosus sectatrix has previously been reported from the ollowing specific localities in this area: Tortugas, Fla., by ordan and Thompson (1905), and Longley and Hildeand (1941); Key West, Fla., by Jordan (1884), Jordan nd Fesler (1893), Evermann and Kendall (1900), and owler (1929; 1945); Card Sound opposite Key Largo, la., by Fowler (1945); Andros Island, Bahamas, by Rosen 911); Fish Market at Nassau, Bahamas by Lee (1889); Vest Palm Beach, Fla., by Fowler (1929); Palm Beach, la., by Fowler (1915); East Coast of Fla., by Goode 879); 31°13′ N. Lat., 74° W. Long., by Bean (1905); harleston (pilot ship) and Magnolia Beach, S.C., by owler (1945); South Carolina, by Lacépède (1803); eaufort Harbor, N.C., by Jordan and Gilbert (1879); eaufort and Cape Lookout, N.C., by Smith (1907); isherman's Island, Va., by Hildebrand and Schroeder 928); Worcester Co., Md., by Truitt, Bean, and Fowler 929); Atlantic City, N.J., by Fowler (1952); Gravesend ay, N.Y., by Bean (1897; 1903); Orient, N.Y., by Nichols nd Breder (1927); Newport, R.I., by Kendall (1908) nd Fowler (1917); and Woods Hole, Mass., by Baird 873) and Smith (1898).

Some of these records may be of *Kyphosus ncisor* since my study revealed that several others dentified as *K. sectatrix* were actually *K. incisor*.

Figure 4 shows the location of capture of pecimens examined from collections of cruises f the *Theodore N. Gill*, *Combat*, and *Silver Bay;* University of Florida specimen, Jupiter nlet, Fla.; Charleston Museum specimens from harleston and Magnolia Beach, S.C.; and U.S. Jational Museum specimens from the Bahamas, ngel Fish Creek, Fla., Broad Creek, Fla., and eaufort, N.C.

Specimens of *K. sectatrix* taken from the folowing locations along the Atlantic coast of the Jnited States are not shown in figure 4: Dry ortugas, Fla., east of Delaware (38°25′ N., 2°40′ W.) and Woods Hole, Mass.

Except for some specimens from the Bahamas nd Tortugas, all taken from the locations indiated (fig. 4) were juveniles, and most of these ere taken under patches of *Sargassum*.

There is probably a northward drift in the Gulf tream and Antilles Current of many of the eveloping young from adult populations in south lorida, the Bahamas, and the West Indies.

Most of the Bahama, Bermuda, and Antilles Current specimens I examined had higher scale and pectoral ray counts than the south Florida adults and most of the juveniles from other areas (tables 4 and 7). Most of the drifting juveniles caught north of south Florida and the Bahamas were probably from south Florida or another location not sampled. Since the specimens from the Caribbean Sea also had higher scale counts, though not as distinct, it is doubtful that many of the more northern juveniles came from there either. The specimen from Turks Island, described by Parr (1930) had a high scale count, as did the specimens I examined from the northern Bahamas.

The largest specimen from north of the Bahamas which I examined (133.0 mm., from Woods Hole, Mass.) approaches the size of the largest reported from the same region, about 6 inches (or about 150 mm.) by Smith (1898) at Woods Hole, Mass. There is no evidence that fully grown adults inhabit the Atlantic coast of the United States north of the Bahama Islands.

Table 8 shows the surface temperatures and salinities of the open waters along the Atlantic coast of the United States and the northern Bahamas at locations from which several juveniles were taken. Unfortunately, these data are not available for the specimens captured along the shoreline of the U.S. coast. Therefore, the indicated ranges of temperature, 23.61° C. to 29.02° C., and salinity, 35.39 °/₀₀ to 36.53 °/₀₀, probably do not represent the ranges of tolerance for this

TABLE 8.—*Surface temperatures and salinities for times and locations of capture of 17 specimens of* Kyphosus sectatrix

[Data taken from the *Theodore N. Gill* cruise reports and unpublished station lists of the *Silver Bay*; specimens arranged individually by size]

Size mm.	Temperature °C.	Salinity °/₀₀	Date	Latitude and Longitude
10.5	28.41	36.27	Jan. 28, 1954	25°32′ N., 76°13′ W.
10.5	28.41	36.27	Oct. 8, 1953	24°28′ N., 77°28′ W.
10.5	28.41	36.27	do	24°28′ N., 77°28′ W.
11.3	28.16	36.12	Sept. 29, 1954	34°34′ N., 74°55′ W.
11.3	26.79	36.06	Apr. 27, 1954	29°00′ N., 79°48′ W.
12.0	24.30	36.53	Jan. 24, 1954	26°20′ N., 76°43′ W.
12.7	26.59	36.31	Sept. 28, 1954	33°44′ N., 76°56′ W.
13.1	27.80	35.39	Oct. 14, 1954	29°00′ N., 79°48′ W.
13.2	28.16	36.12	Sept. 29, 1954	34°34′ N., 74°55′ W.
15.0	28.07	35.91	Oct. 12, 1953	27°37′ N., 79°40′ W.
18.4	28.08	35.94	Oct. 14, 1953	29°36′ N., 79°58′ W.
26.4	24.20	36.52	Jan. 23, 1954	26°21′ N., 76°44′ W.
26.8	26.44	36.22	Oct. 26, 1953	32°18′ N., 77°29′ W.
28.5	26.40	36.29	Oct. 24–25, 1953	31°28′ N., 78°42′ W.
33.3	29.02	36.07	Sept. 13, 1954	29°40′ N., 80°00′ W.
34.7	27.75	36.47	June 13, 1954	26°23′ N., 76°46′ W.
52.0	23.61		Oct. 26, 1959	32°15′ N., 79°14′ W.

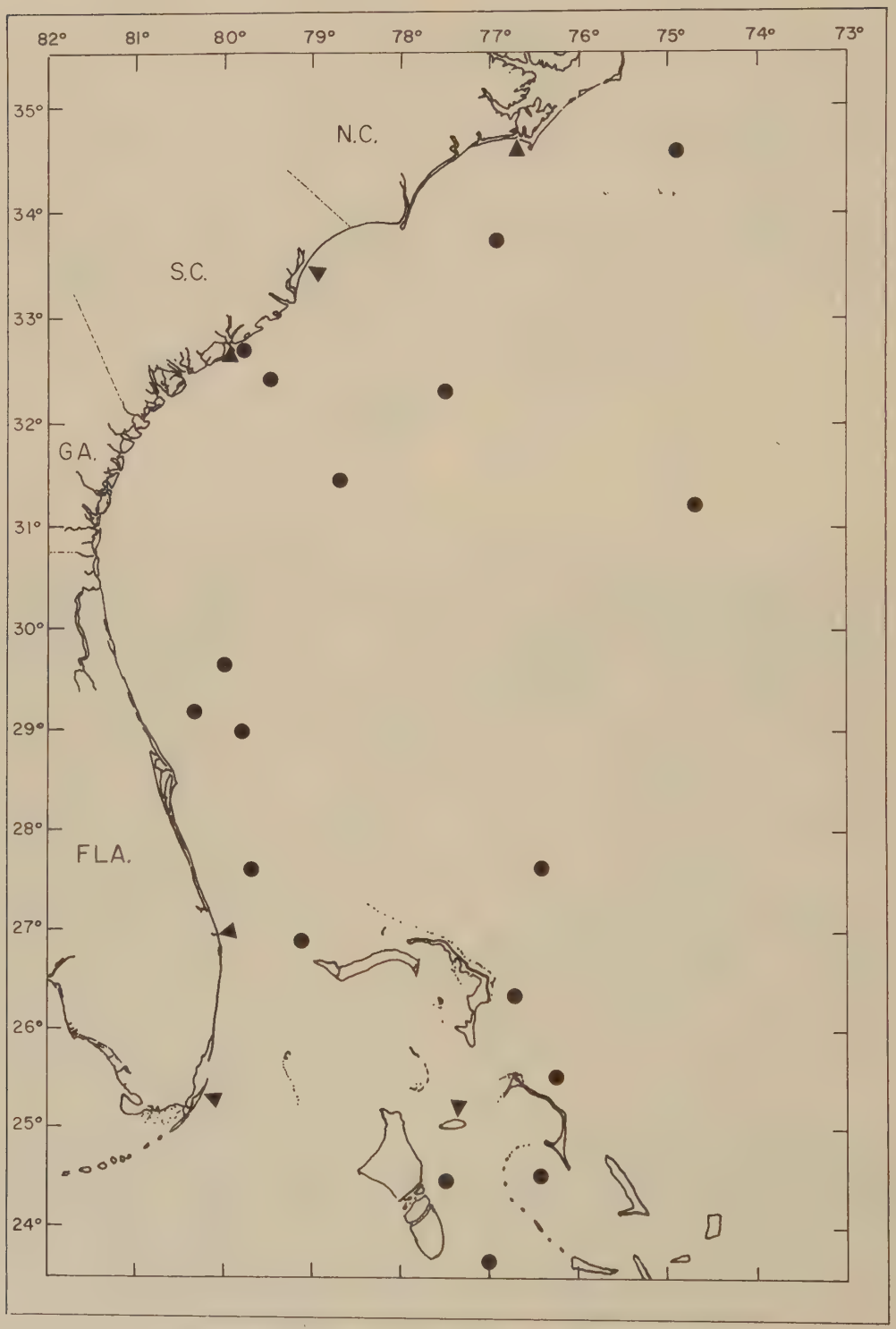

FIGURE 4.—Locations of capture of *Kyphosus sectatrix* along the southeastern Atlantic coast of the United States and the northern Bahamas. Triangles denote capture along shoreline, and dots denote capture in open water.

pecies but may represent the optimum ranges for eveloping juveniles. Bean (1897) reported this pecies to be hardy in the aquarium but unable to ndure winter temperature.

At Woods Hole, Mass., in April, the month mith (1898) reported this species, the highest aily surface water temperature taken over an 1-year period was 11.67° C. (U.S. Department f Commerce, 1955). At Montauk, N.Y., about 5 miles from Orient where Nichols and Breder 1927) reported this species taken on November , 1915, the highest November surface water temperature recorded during 8 years of sampling was 15.55° C. These records indicate a tolerance of these low temperatures for at least a short period. The scarcity of this species in fish collections made north of Cape Hatteras suggests *K. sectatrix* cannot endure low temperatures.

Size frequency data for small specimens show that specimens under 20 mm. were taken during several parts of the year (fig. 5). This possibly would indicate that spawning occurs over a wide period of time during the year, which is common among many fishes in tropical and semitropical

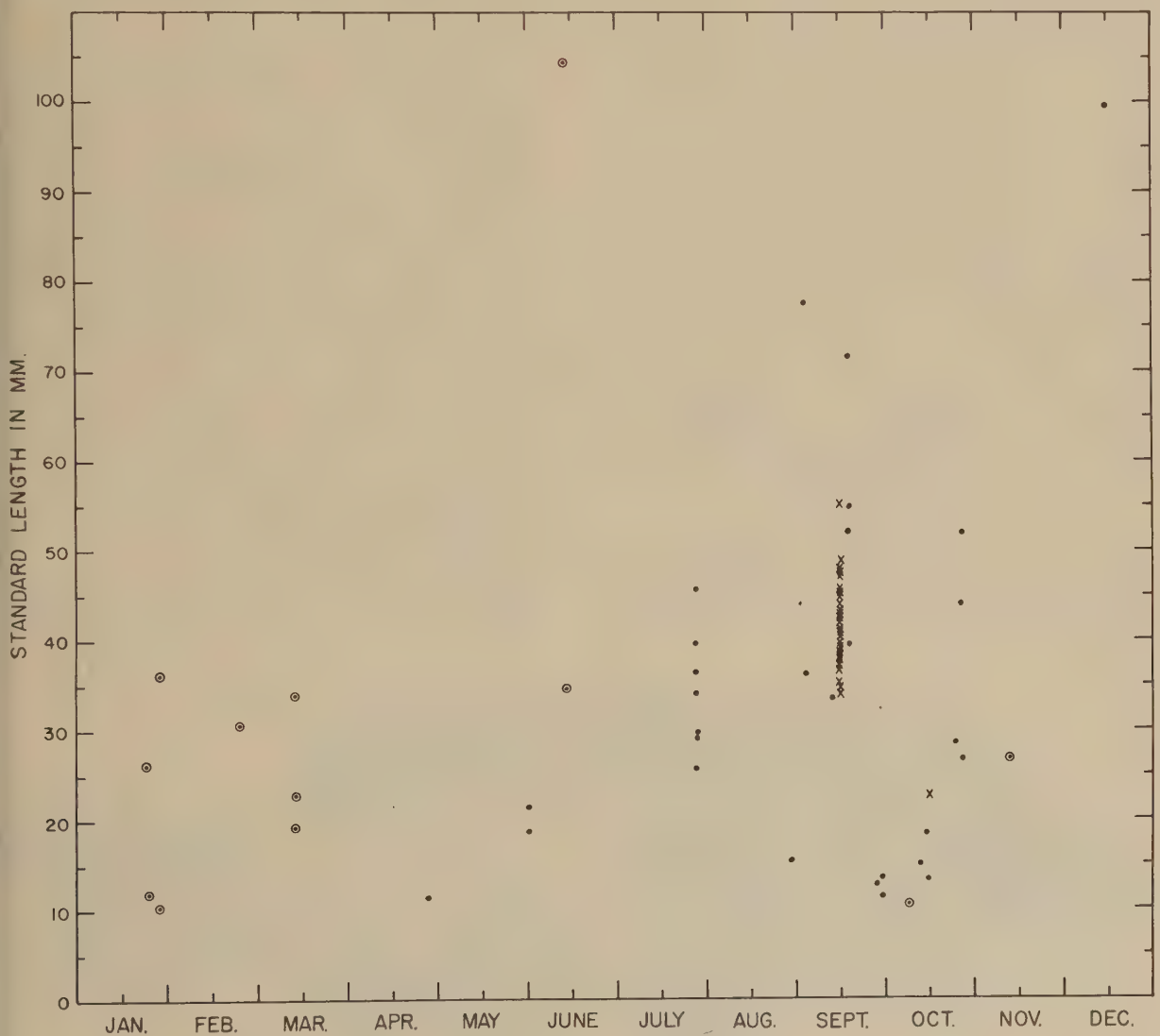

FIGURE 5.—Size distribution, by months, of 90 specimens of *Kyphosus sectatrix* taken along the Atlantic coast of the United States and the northern Bahamas. X's denote specimens having only month and year recorded in date of capture, and circles denote specimens captured in the northern Bahamas (including Antilles Current and excluding Florida Current).

waters. The sampling effort was not uniform throughout the seasons, therefore, many localities were not sampled during certain months.

Most of my specimens from the Bahamas and Antilles Current probably came from fall and winter spawning, and most from along the rest of the Atlantic coast of the United States probably came from spring and summer spawning.

KYPHOSUS INCISOR (CUVIER)

Pimelepterus incisor Cuvier in Cuvier and Valenciennes, 1831: p. 266 (Brazil).

Pimelepterus flavo-lineatus Poey, 1866: p. 319 (Havana).

The nomenclature of *Kyphosus incisor*, like *K. sectatrix*, has been decisive since Jordan and Gilbert (1883) brought widespread attention to the correct generic name, *Kyphosus* [Lacépède (1802) for *Kyphosus bigibbus*]. The authority given for *K. incisor* has varied among Cuvier and Valenciennes, Cuvier, and Parkinson. In his description Cuvier (Cuvier and Valenciennes, 1831) gave credit to Parkinson for having sketched and named this species *Chaetodon incisor;* however, he did not cite a previous paper.

The genus and species *Seleima aurata* Bowdich (1825) is listed in doubtful synonymy to *K. incisor* by Jordan, Evermann, and Clark (1930). The description by Bowdich (1825) for *Seleima aurata* is without doubt not a description of *Kyphosus.*

DEVELOPMENT

Dorsal fin.—IX (1 specimen), X (3 specimens), XI (61 specimens), or XII (1 specimen)—13 (33 specimens), 14 (65 specimens), or 15 (1 specimen) (table 9). Full complement of total dorsal ra (spines and soft-rays combined) is present by 8 mm. and the soft-rays are all segmented and u branched except for the last which is divided its base (fig. 6). Some specimens from 8.5 to 10 mm. long have the last spine pointed, but se mented, indicating near completion of the trans tion from segmented ray to unsegmented spi noted also in *K. sectatrix.* By 17.2 mm., the ne to last ray has branched, and by 17.5 mm., a but the first two soft-rays and the posterior el ment of the last have branched. By 19.0 mm only the first soft-ray remains unbranched; all hav branched by 25.8 mm.

In this species the spines are inserted alternatel to the left and right of the mid-dorsal line as in *sectatrix.* Two spines articulate to the same bor in the fin of the single specimen with 12 spines.

Anal fin.—III (66 specimens)—12 (17 spec mens) or 13 (82 specimens) (table 9). The fu complement of total anal rays (spines and sof rays combined) is present by 8.5 mm. (fig. 6 One at 8.7 mm. has the third ray pointed but sti segmented, indicating a transition from segmente ray to unsegmented spine as in the dorsal fi From 8.5 to 17.2 mm., the soft-rays are all seg mented and unbranched except for the last whic is divided to its base. By 17.5 mm., all but th first two soft-rays and the posterior element of th last ray have branched. By 19.0 mm., only th first remains unbranched and it is branched b 21.7 mm.

Pectoral fin.—18 (7 specimens), 19 (58 speci mens), or 20 (6 specimens) soft-rays (table 4). Th

FIGURE 6.—*Kyphosus incisor* juvenile, 8.5 mm. (preserved for 2 years).

TABLE 9.—*Number of dorsal and anal soft-rays on 99 specimens of* Kyphosus incisor

Number of anal soft-rays	Number of dorsal soft-rays: 13	14	15
12	12 (12.1)	5 (5.0)	------- --
13	21 (21.2)	60 (60.6)	1 (1.0)

NOTE.—Open figures denote numbers; figures in parentheses denote percentages of specimens having respective combinations of numbers of soft-rays.

full complement of pectoral rays is present by 8.5 mm. The 2nd through 9th rays have flattened tips, and the 10th to the last have stout tapering tips (fig. 6). By about 10 mm., the 2nd through the last ray have flattened tips, and the 2nd through the 13th rays are segmented (fig. 7). At 15.8 mm., all rays are still unbranched, all but the first and last are segmented, and all but the first two and last one have flattened tips. By 28.4 mm., all the rays are segmented (one segment appearing in the first) and all but the first two and the last one are branched. At 50 mm., there has been no further branching. The last ray is branched by 58 mm., but the first two rays remain unbranched to 252 mm., the largest specimen examined.

Pelvic fin.—I, 5 (54 specimens). The full complement of pelvic rays is present by 8.5 mm. (fig. 6). All soft-rays are segmented but unbranched from 8.5 to 9.8 mm. (figs. 6 and 7). By 10 mm., the middle ray has branched, and by 13.6 mm., all soft-rays have branched.

Caudal fin.—9+8 principal rays (53 specimens) and 10+9 secondary rays in a fully formed caudal fin (the secondary rays were examined in cleared and stained specimens only). By 8.5 mm., all of the principal rays have formed, are segmented, and have flattened tips (fig. 6). A 10-mm. specimen had 9+8 secondary rays; the first on each lobe was an imbedded rudiment. By 11.4 mm., the secondary ray nearest the principals on the dorsal lobe is segmented. By 12.1 mm., the second ray from the principal rays on the ventral lobe is segmented. By 13.2 mm., the middle principal rays are just beginning to branch, and by 14.7 mm., the 12 middle principal rays have branched (fig. 8). A 15.8-mm., specimen had 10+8 secondary rays. By 16.1 mm., branching

FIGURE 7.—*Kyphosus incisor* juvenile, 9.8 mm. (preserved for 7 years).

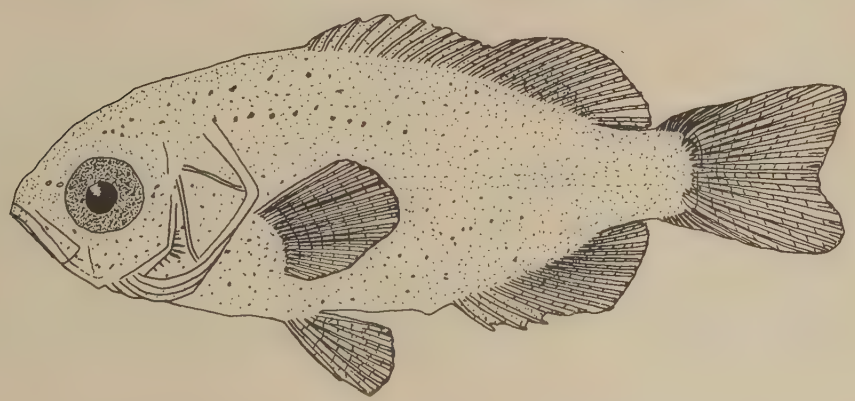

FIGURE 8.—*Kyphosus incisor* juvenile, 14.7 mm. (preserved for 7 years).

is complete (the principal ray nearest the secondaries on each lobe does not branch). By 19.2 mm., the two secondary rays adjacent to the principal rays, in both dorsal and ventral lobes, are segmented. A 28.4-mm. specimen had 10+9 secondary rays.

Gill rakers.—Entire first arch, 22 to 31; upper limb, 5 to 9; lower limb, 17 to 23; ceratobranchial bone, 13 to 15 (tables 10 and 11). The counts indicate a steady slow increase in number of gill rakers from 10 to 50 mm. with no increase beyond 50 mm.

Since this increase occurs in both limbs, the increase for the entire arch is more pronounced. The ceratobranchial-bone count, while showing the same trend, shows the least change; the change is probably the result of migration of the last raker, as in *K. sectatrix*.

Scales.—Row above lateral line, 63 to 73; straight line, 54 to 62 (table 7). By 8.5 mm., the sides are covered with scales from the pectoral base to the caudal peduncle and from just above the lateral line to the ventral edge of the pectoral base, with the same proportionate width back to the peduncle.

From 10 to 252 mm., the development of scales parallels that of *K. sectatrix*.

Teeth.—Dentition of the 10.0-, 15.8-, and 28.4-mm. specimens was determined by clearing and staining.

On a 10.0-mm. specimen, only premaxillary and dentary teeth were present; there were about 10 caniniform teeth in a row on each premaxillary and four on each dentary, all in various stages of development.

On a 15.8-mm. specimen, each premaxillary had 11 or 12 uneven caniniform teeth in a row, and each dentary had 4 or 5.

TABLE 10.—*Number of gill rakers on upper and lower limb of first arch on 63 specimens of* Kyphosus incisor *larger than 16 mm.*

Number of upper-limb gill rakers	Number of lower-limb gill rakers: 19	20	21	22	23
6	6 (9.5)	6 (9.5)	--------	--------	--------
7	4 (6.3)	21 (33.3)	11 (17.5)	1 (1.6)	--------
8	--------	4 (6.3)	4 (6.3)	4 (6.3)	1 (1.6)
9	--------	--------	1 (1.6)	--------	--------

NOTE.—Open figures denote the numbers, and figures in parentheses, the percentages of specimens having respective combinations of numbers of gill rakers.

On a 28.4-mm. specimen, each premaxillary had 10 or 12 teeth in a row, half were caniniform and half were incisiform; and each dentary had 11 or 12 caniniform teeth in a row, with other teeth behind these rows on each jaw. The vomer had about 12 villiform teeth, each of 2 parallel patches on the posterior surface of the tongue had 6 villiform teeth, and the pterygoid had 2 villiform teeth in a tiny patch on the posterior surface.

From about 100 mm., the teeth resembled those of adult *K. sectatrix*.

Pigmentation.—By 8.5 mm., the smallest specimen examined, there are blotches of brownish-gray pigment with large blackish spots in the background and small black spots on the scales (fig. 6). The brownish-gray pigment extends over most of the spines and parts of the soft-dorsal and anal fins, but not over the area around the first three soft-rays of each fin. It also extends to the middle of the pelvic fins, with a few small black spots on these fins. On specimens about the same size, but preserved more than five years, the dark spots are distinct with no gray-brown pigment covering. The pectorals have some dark spots and stripes

TABLE 11.—*Variation in number of gill rakers on first arch of* Kyphosus incisor

[Specimens grouped by size]

Standard length	Number of specimens with gill rakers on first arch numbering—																									
	Entire arch										Upper limb					Lower limb							Ceratobranchial bone		
	22	23	24	25	26	27	28	29	30	31	5	6	7	8	9	17	18	19	20	21	22	23	13	14	15
8.5–15.9 mm	1	----	1	1	----	----	----	----	----	----	1	2	----	----	----	2	1	1	----	----	----	----	2	2	----
16.0–19.9 mm	----	----	----	3	2	1	1	----	----	----	----	5	2	----	----	----	----	3	3	1	----	----	----	4	----
20.0–29.9 mm	----	----	----	3	5	10	5	2	----	----	----	7	15	3	----	----	----	4	15	6	----	----	----	8	15
30.0–39.9 mm	----	----	----	----	3	6	4	2	----	1	----	----	14	2	----	----	----	3	5	6	1	1	1	6	9
40.0–49.9 mm	----	----	----	----	----	4	2	----	----	----	----	----	5	1	----	----	----	----	5	2	----	----	----	4	3
50.0–149.9 mm	----	----	----	----	----	----	1	1	2	----	----	----	1	3	----	----	----	----	1	1	2	----	----	----	4
150.0–252.0 mm	----	----	----	----	----	----	2	----	3	----	----	----	----	4	1	----	----	----	2	2	1	----	----	----	5

parallel and adjacent to the rays. The spots are present on the spinous-dorsal and anal fins and around the bases of the dorsal soft-rays. On the sides there are many pigment spots ranging from brown to black. Most of the larger spots have many narrow rays of pigment radiating out from each spot. The largest spots occur on the upper half of the side. The area over the gut cavity has spots larger than those on the rest of the lower half of the side, but smaller than those above. A straight line of black dashes under the surface lies on the middle of the side, at and just forward of the caudal peduncle; they are more visible on specimens preserved for an extended period of time (see fig. 7, 9.8 mm.).

By about 10 mm., the blotched gray pigment has become more distinct on the fresher specimens, however, the areas of pigment are about the same. The specimens, at this size, preserved for an extended time have slightly smaller dark spots than do the smaller fish (fig. 7).

On fresh specimens from about 11 to slightly longer than 13 mm., the gray pigment is more uniform (fig. 9A), which may be due to alternating color patterns like those found in *K. sectatrix* (Townsend, 1929). The pigment on the dorsal, anal, and pelvic fins is much darker than on most other parts. There still is no pigment on the caudal fin and little on the pectorals. The pigment on the soft dorsal ranges from none to some around the first three soft-rays. The preserved specimens of this size are similar to the fresh except that the gray is now brown. In the more faded condition, the dark spots are more pronounced than in the fresh condition, but not so distinct as in the smaller faded fish.

By about 15 mm., some specimens have pigment spots extending beyond the middle of the caudal

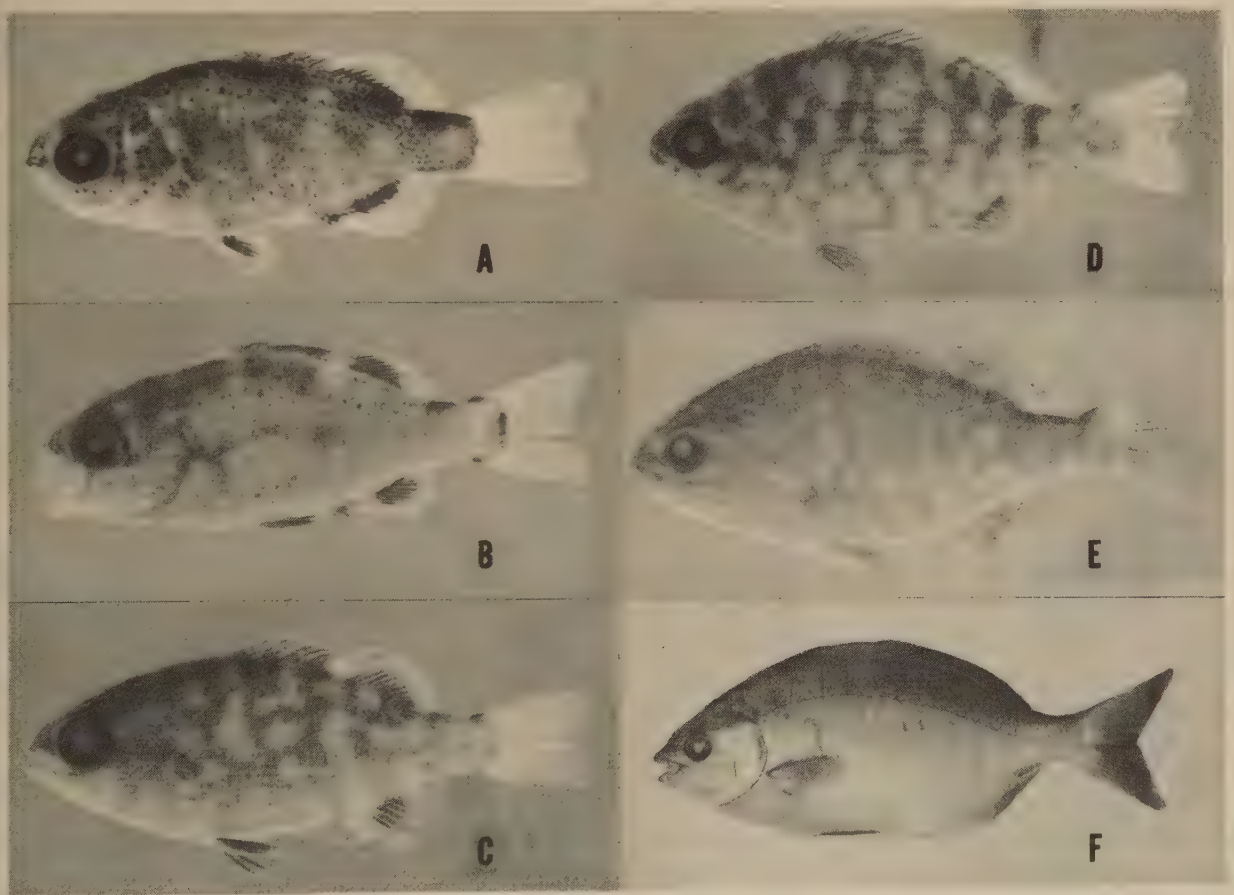

FIGURE 9.—*Kyphosus incisor;* A, juvenile, 13.2 mm. (preserved for 3 months); B, juvenile, 17.6 mm. (preserved for 2 years); C, juvenile, 21.2 mm. (preserved for 9 months); D, juvenile, 33.6 mm. (preserved for 3 years); E, juvenile, 54.5 mm. (preserved for 7 years); F, adult, 252.0 mm. (preserved for 74 years).

base (fig. 8). The fresher specimens show large patches of buff on brownish sides. Pigment spots extend further out on the soft dorsal and anal and cover most of the pectorals. In most fish through this size the first three soft-rays generally lack pigment.

From about 17 to 21 mm., the pigment covers more than half of the soft dorsal and anal fins. Extensive pigment over the anterior portions of these fins is more common than on the smaller specimens. There are light and dark streaks along the scale rows, and the patterns vary from light patches on dark background to a uniform slate gray, with the pigment on all but the pectoral fin being much darker (fig. 9B). By 21.2 mm., the pigment extends across the entire base of the caudal (fig. 9C).

From about 22 to 30 mm., there is a fine stippling of dark spots over most of the caudal and pectoral and the last two or three rays of the dorsal and anal. The stippling of the anterior third of the caudal is dense.

By 33.6 mm., the stippling on the fins is more dense (fig. 9D), even on very faded specimens. A darker band of pigment with black spots is becoming evident along the outer row of scales on the dorsal, anal, and caudal fins.

By 54.5 mm., the black band at the outer row of scales on the dorsal and anal fins has become more distinct (fig. 9E), and the dark spots on the sides of the fish are no longer apparent.

The larger specimens examined were old and had a uniform brassy appearance on the sides, with buff-tan on the underside (fig. 9F). The darker and lighter bands along the scale rows are apparent, and the fins have a more uniform dark buff color.

DISTRIBUTION ALONG ATLANTIC COAST OF THE UNITED STATES AND NORTHERN BAHAMAS

Kyphosus incisor has previously been reported from the following specific localities in this area: Tortugas, Fla., by Jordan and Thompson (1905) and Longley and Hildebrand (1941); and Nantucket, Mass., by Nichols and Breder (1927) who said, "the identification is open to question." The most northerly definite record of *K. incisor*, from off Cape Hatteras, N. C., is in the preliminary identification of the *Theodore N. Gill* cruise collection of specimens (Anderson and Gehringer, 1959b).

Figure 10 shows the location of capture of specimens examined from the collections of the *Gill*, *Combat*, and *Silver Bay*, and from St. Simons Island, Ga.; University of Florida specimens from Palm Beach and Jupiter Inlets, Fla.; Charleston Museum specimens from Charleston and Magnolia Beach, S.C.; and USNM specimens from Key West, Fla., Nassau, Bahamas, Beaufort, N.C., and Capes Lookout and Hatteras, N.C.

Specimens of *K. incisor* taken from the following locations along the Atlantic coast of the United States are not shown in figure 10: Tortugas, Fla.; east of Delaware (38°50′ N., 70°07′ W.); east of New Jersey (40°03′ N., 67°27′W.); and Woods Hole, Mass. Aside from the Woods Hole specimen (101.5 mm.), all from north of Nassau were less than 60 mm.; the only specimens longer than 150 mm. were from Nassau and the Tortugas.

These data give the following new inshore records for *K. incisor:* Key West, Fla.; Jupiter Inlet, Fla.; Palm Beach, Fla.; Nassau, Bahamas; St. Simons Island, Ga.; Charleston, S.C.; Magnolia Beach, S.C,; Beaufort, N.C.; and Woods Hole, Mass.; and new records far offshore east of Delaware and New Jersey. All specimens captured on cruises of the *Combat* and *Silver Bay* are from new locations. All of the Charleston Museum specimens from Charleston and Magnolia Beach, S.C., were identified as *K. sectatrix* by Fowler (1945), however, some are *K. incisor*.

Most juveniles were taken under patches of *Sargassum*, often along with *K. sectatrix*. The locations indicated in figure 10 suggest, even more distinctly, a northward drift in the Gulf Stream and Antilles Current than did the locations for *K. sectatrix*, especially off North Carolina.

Table 12 shows the surface temperatures and salinities of the waters from which several juveniles were taken. The extremes recorded were similar to those recorded for *K. sectatrix*, except for the lower extreme of salinity from a shoreline location (27.85 °/₀₀ at St. Simons Island, Ga.). The month of capture was not reported for the specimen from Woods Hole, Mass., but the highest surface temperature recorded there was 25.00° C. (U.S. Department of Commerce, 1955).

Size frequency data for small specimens indicate that spawning occurs during much of the year (fig. 11) as in *K. sectatrix*. All of the specimens less than 20 mm. were captured from May through December, suggesting that the spawning activity

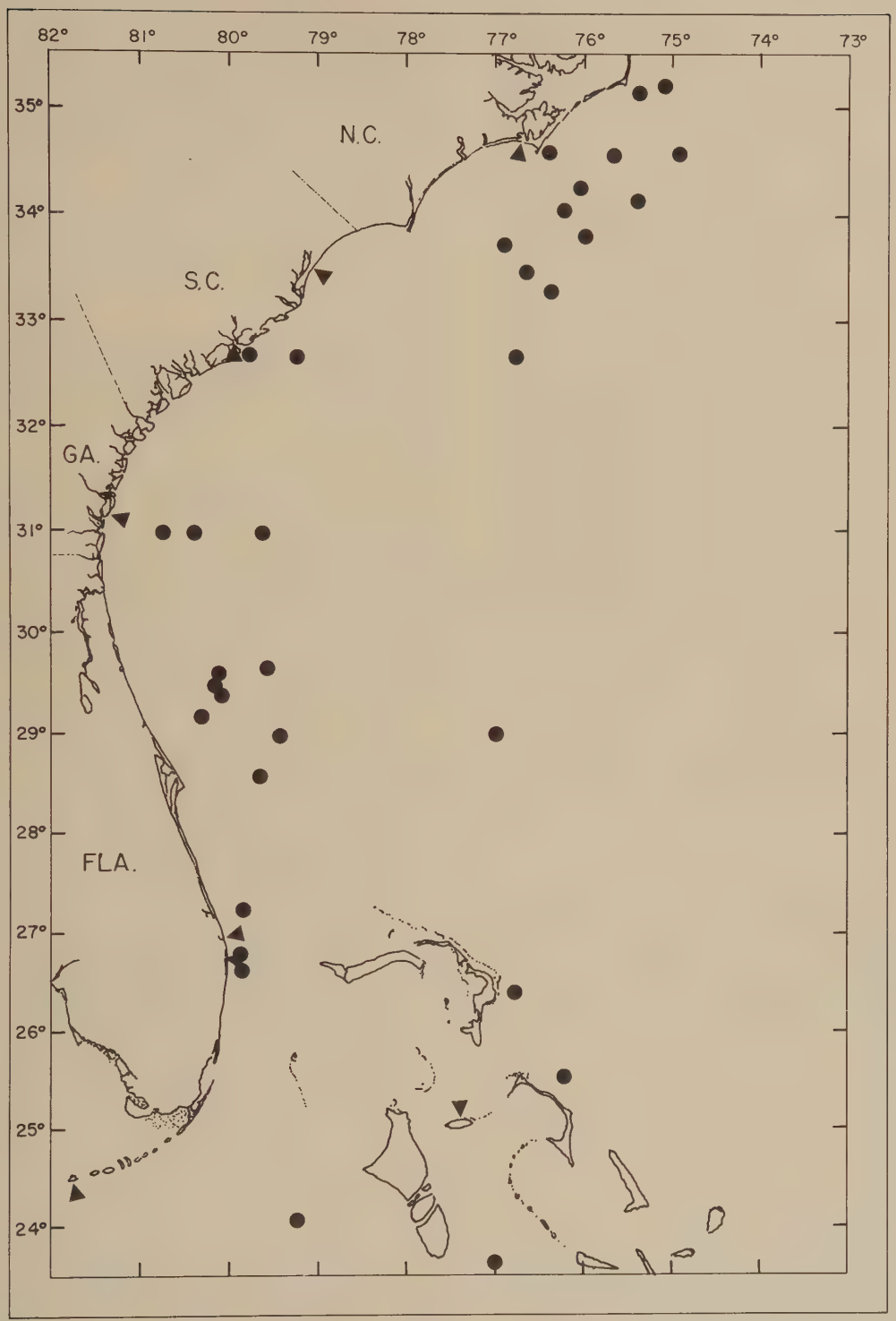

FIGURE 10.—Locations of capture of *Kyphosus incisor* along the southeastern Atlantic coast of the United States and the northern Bahamas. Triangles denote capture along shoreline, and dots denote capture in open water.

TABLE 12.—*Surface temperatures and salinities for times and locations of capture of 41 specimens of* Kyphosus *incisor*

[Data from the *Theodore N. Gill* cruise reports, unpublished lists of the *Silver Bay*, and seining records of the Bureau of Commercial Fisheries Biological Laboratory, Brunswick, Ga., specimens arranged by size]

Size mm.	Temperature °C.	Salinity ‰	Date	Latitude and longitude
8.7	27.94	36.04	Oct. 14, 1953	29°00′ N., 79°26′ W.
9.1	28.54	35.96	June 15, 1954	29°38′ N., 79°36′ W.
9.8	27.62	35.84	Aug. 11, 1953	33°29′ N., 76°40′ W.
10.0	28.54	35.96	June 25, 1954	29°38′ N., 79°36′ W.
10.3	28.89		July 24, 1960	34°34′ N., 75°40′ W.
11.4	28.89		do	Do.
11.9	28.89		do	Do.
12.1	27.62	35.84	Aug. 11, 1953	33°29′ N., 76°40′ W.
12.7	27.96	36.24	July 17, 1953	29°00′ N., 77°00′ W.
13.1	28.89		July 24, 1960	34°34′ N., 75°40′ W.
13.2	28.89		do	Do.
13.5	25.98	35.68	Sept. 24, 1954	35°08′ N., 75°22′ W.
13.6	25.04	36.36	May 8, 1953	33°15′ N., 76°23′ W.
13.7	25.04	36.36	do	Do.
14.2	27.62	35.84	Aug. 11, 1953	32°29′ N., 76°40′ W.
14.3	26.59	36.31	Sept. 28, 1954	33°44′ N., 76°56′ W.
14.3	27.62	35.84	Aug. 11, 1953	33°29′ N., 76°40′ W.
14.7	28.12	36.22	July 19, 1953	26°23′ N., 76°48′ W.
15.5	28.16	36.12	Sept. 29, 1954	34°34′ N., 74°55′ W.
16.2	28.81	36.02	Aug. 10, 1953	32°39′ N., 76°46′ W.
16.4	25.04	36.36	May 8, 1953	33°15′ N., 76°23′ W.
16.7	24.91	36.00	Oct. 16, 1953	31°00′ N., 80°23′ W.
17.2	27.51	36.55	June 13–14, 1954	26°20′ N., 76°47′ W.
18.2	[1] 27.85	[1] 36.15	Oct. 16, 1953	30°58′ N., 79°38′ W.
18.6	28.18	32.26	July 10, 1954	33°50′ N., 75°59′ W.
19.0	27.88	36.53	do	34°04′ N., 76°14′ W.
21.2	23.89		Jan. 28, 1960	29°36′ N., 80°08′ W.
23.4	23.89		Oct. 24, 1959	32°40′ N., 79°16′ W.
24.7	24.91	36.00	Oct. 16, 1953	31°00′ N., 80°23′ W.
25.4	23.89		Oct. 24, 1959	32°40′ N., 79°16′ W.
25.8	23.89		do	Do.
26.3	23.89		do	Do.
27.5	23.89		do	Do.
27.7	23.89		do	Do.
28.4	24.91	36.00	Oct. 16, 1953	31°00′ N., 80°23′ W.
28.6	23.89		Oct. 24, 1959	32°40′ N., 79°16′ W.
29.6	23.89		do	Do.
31.0	23.89		do	Do.
34.5	28.09	36.17	Sept. 9, 1954	34°09′ N., 75°24′ W.
37.5	24.25	35.37	Oct. 16, 1953	31°00′ N., 80°46′ W.
44.5	26.11	27.85	Oct. 5, 1955	St. Simons Island, Ga.

[1] Taken 10 meters below the surface.

is greatest during the spring and summer. It appears that the growth rate for juveniles may be as low as 10 mm. per month; however, my data were insufficient to establish the rate.

BODY PROPORTIONS OF *KYPHOSUS SECTATRIX* AND *KYPHOSUS INCISOR*

Eye diameter.—The relation of eye diameter to standard length indicates a very gradual decrease in rate of increase during growth, with no distinct inflections (fig. 12).

Eye diameter expressed as percentage of standard length ranged 11.2–16.5 percent from 8.5 to 30 mm., 10.4–13.4 percent from 30 to 60 mm., 8.3–12.0 percent from 60 to 150 mm., and 6.9–10.2 percent from 150 to 260 mm. (table 13).

Head length.—The relation of head length to standard length indicates a nearly constant rate of increase to about 50–60 mm. An inflection occurs at this size, with the rate of increase beyond 50–60 mm. constant but slightly lower than initially (fig. 13).

Head length expressed as percentage of standard length ranged 31.7–38.8 percent from 8.5 to 30 mm., 31.3–36.7 percent from 30 to 50 mm., 31.3–34.5 percent from 50 to 100 mm., and 25.5–32.0 percent from 100 to 260 mm. (table 13).

Body depth at pelvic fin.—The relation of body depth at pelvic fin to standard length shows a nearly constnt rate of increase through all sizes (fig. 14).

Body depth at pelvic fin expressed as percentage of standard length ranged 31.8–40.7 percent from 8.5 to 15 mm., 34.8–44.0 percent from 15 to 30 mm., and 38.4–47.7 percent from 30 to 260 mm. (table 13).

Snout to dorsal fin.—The relation of distance from snout to dorsal fin to standard length indicates a constant rate of increase through all sizes (fig. 15).

Distance from snout to dorsal fin expressed as percentage of standard length ranged 42.8–50.6 percent from 8.5 to 30 mm. and 38.8–47.5 percent from 30 to 260 mm. (table 13).

Snout to anal fin.—The relation of distance from snout to anal fin to standard length indicates a uniform rate of increase through all sizes (fig. 16).

Distance from snout to anal fin expressed as percentage of standard length ranged 60.8-68.4 percent from 8.5 to 20 mm. and 58.0-68.8 percent from 20 to 260 mm. (table 13).

Snout to pectoral fin.—The relation of distance from snout to pectoral fin to standard length shows an inflection in rate of increase at about 50-60 mm., with the rate beyond 50-60 mm. constant but lower than the initial rate (fig. 17).

Distance from snout to pectoral fin expressed as percentage of standard length ranged 31.3-40.0 percent from 8.5 to 20 mm., 28.7-36.8 percent from 20 to 60 mm., 26.6-31.2 percent from 60 to 140 mm., and 24.5-28.7 percent from 140 to 260 mm. (table 13).

Snout to pelvic fin.—The relation of distance from snout to pelvic fin to standard length shows a very gradual reduction in rate of increase from the smallest size to about 50-60 mm., after which the rate of increase appears constant and less than initially (fig. 18).

Distance from snout to pelvic fin expressed as percentage of standard length ranged 39.3-48.4

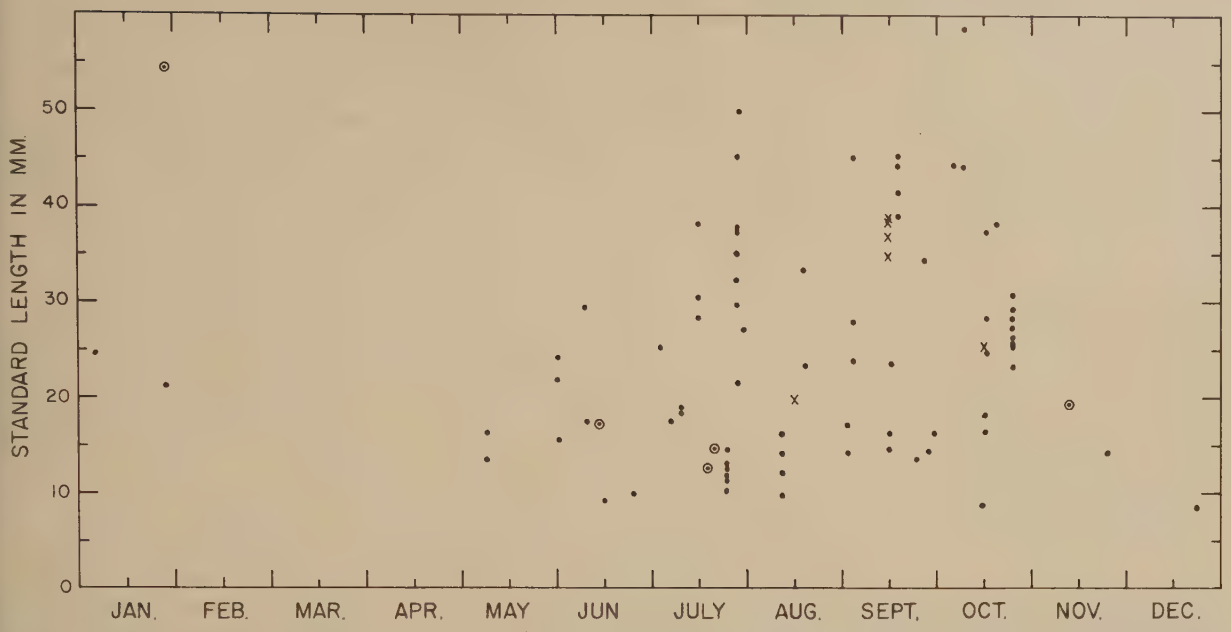

FIGURE 11.—Size distribution, by months, of 92 specimens of *Kyphosus incisor* taken along the Atlantic coast of the United States and the northern Bahamas. X's denote specimens having only month and year recorded in date of capture, and circles denote specimens captured in the northern Bahamas (including Antilles Current and excluding Florida Current).

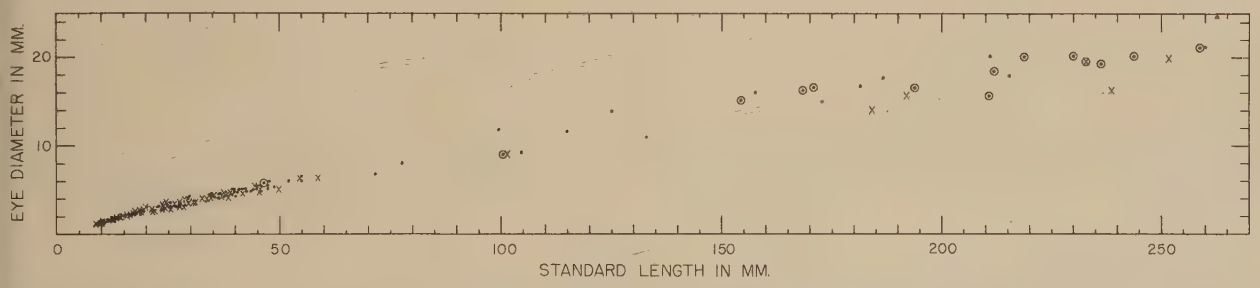

FIGURE 12.—Relation of eye diameter to standard length on 115 specimens of *Kyphosus sectatrix* and 99 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

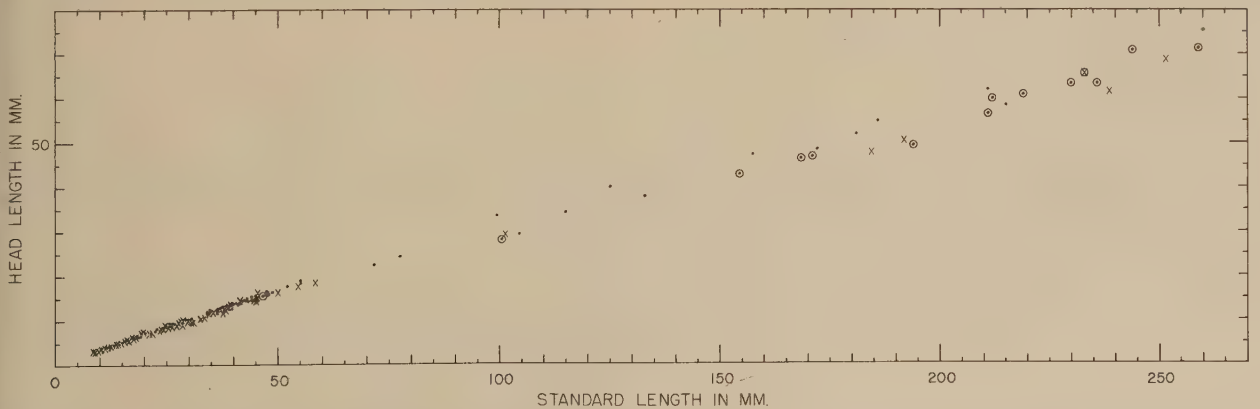

FIGURE 13.—Relation of head length to standard length on 115 specimens of *Kyphosus sectatrix* and 99 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

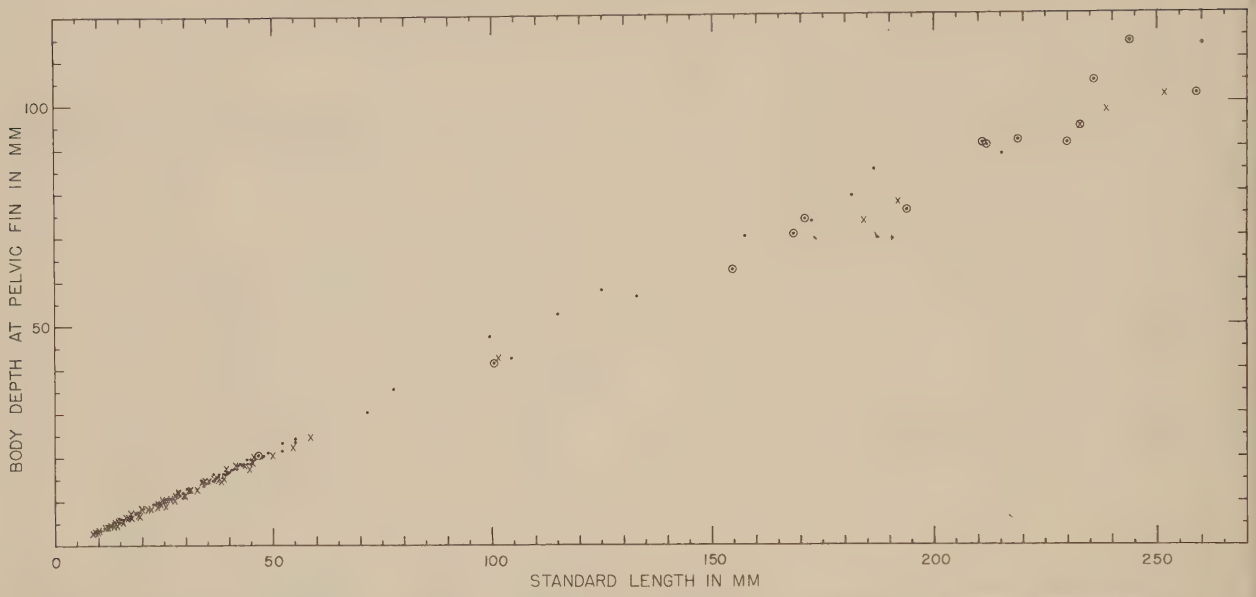

FIGURE 14.—Relation of body depth at pelvic fin to standard length on 115 specimens of *Kyphosus sectatrix* and 99 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

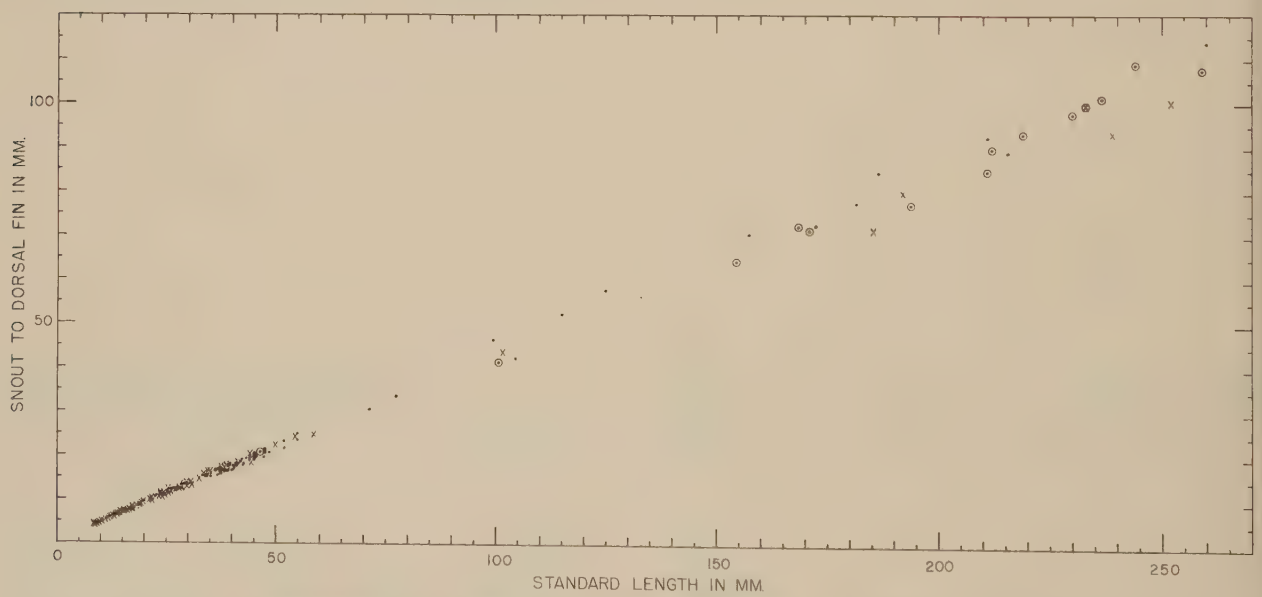

FIGURE 15.—Relation of distance snout-to-dorsal fin to standard length on 115 specimens of *Kyphosus sectatrix* and 97 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

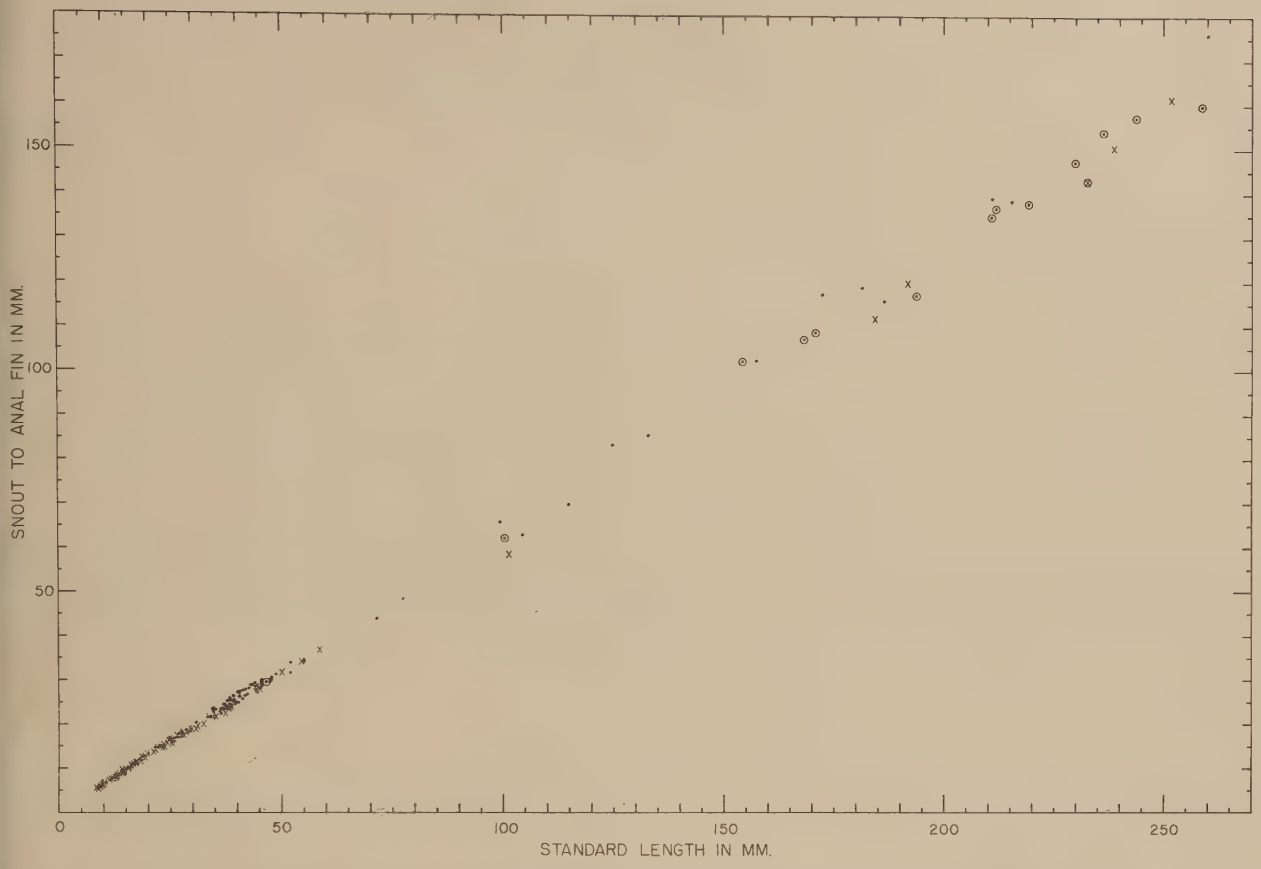

FIGURE 16.—Relation of distance snout-to-anal fin to standard length on 115 specimens of *Kyphosus sectatrix* and 98 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

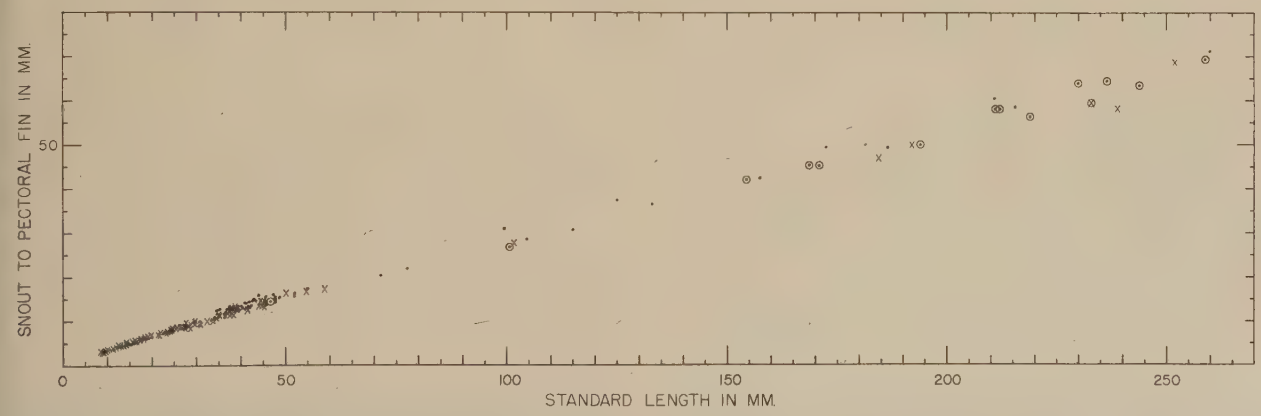

FIGURE 17.—Relation of distance snout-to-pectoral fin to standard length on 115 specimens of *Kyphosus sectatrix* and 99 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

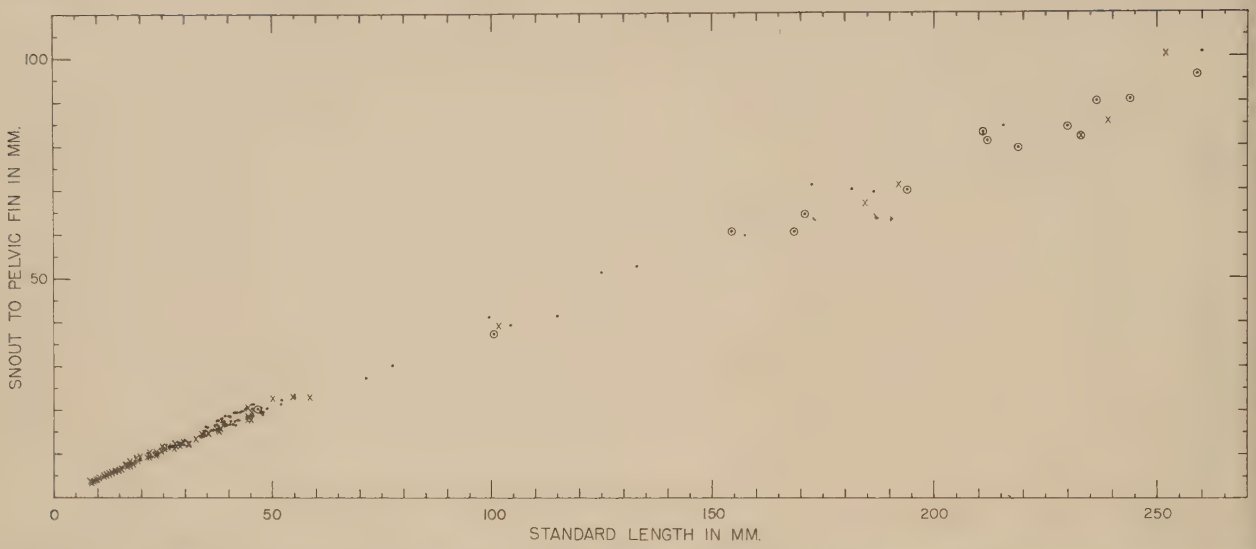

FIGURE 18.—Relation of distance snout-to-pelvic fin to standard length on 115 specimens of *Kyphosus sectatrix* and 99 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

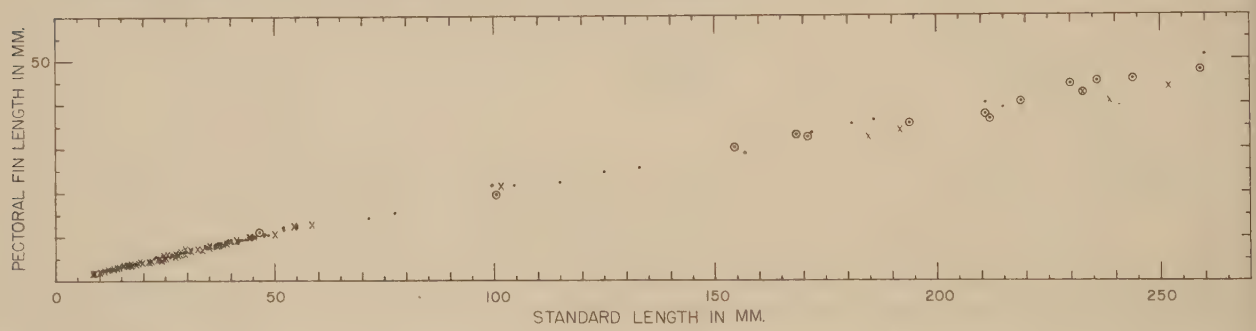

FIGURE 19.—Relation of pectoral fin length to standard length on 100 specimens of *Kyphosus sectatrix* and 94 specimens of *Kyphosus incisor*. Dots denote *K. sectatrix*, X's denote *K. incisor*, and circles denote capture beyond the Atlantic coast of the United States and the northern Bahamas.

percent from 8.5 to 60 mm. and 35.2-41.2 percent from 60 to 260 mm. (table 13).

Pectoral fin length.—The relation of pectoral fin length to standard length shows a uniform rate of increase to about 50-60 mm., with the rate beyond 60 mm. relatively uniform but lower than initially (fig. 19).

Pectoral fin length expressed as percentage of standard length ranged 18.9-24.1 percent from 8.5 to 20 mm., 19.4-24.1 percent from 20 to 60 mm., and 16.9-21.9 percent from 60 to 260 mm. (table 13).

COMPARISON OF THE SPECIES

ANATOMY AND APPEARANCE

Dorsal fin.—No interspecific variation in number of dorsal spines was observed, as more than four-fifths of the specimens of each species had 11 spines. Number of dorsal soft-rays is one of the best characters for separating *K. sectatrix* from *K. incisor* (fig. 20). In *K. sectatrix* 91 percent had 12 rays; in *K. incisor* 99 percent had 13 or 14 rays. Soft-rays start branching by 13.1 mm. in *K. sectatrix*, but not before 17.2 mm. in *K. incisor*.

Anal fin.—No interspecific variation in number of anal spines was observed. Number of anal soft-rays is another good character for separating *K. sectatrix* from *K. incisor* (fig. 20). In *K. sectatrix* 95 percent had 11 rays; in *K. incisor* 100 percent had 12 or 13 rays. Soft-rays start branching by 15.0 mm. in *K. sectatrix*, but not before 17.5 mm. in *K. incisor*.

Pectoral fin.—Interspecific variation in number of pectoral rays was indistinct throughout the

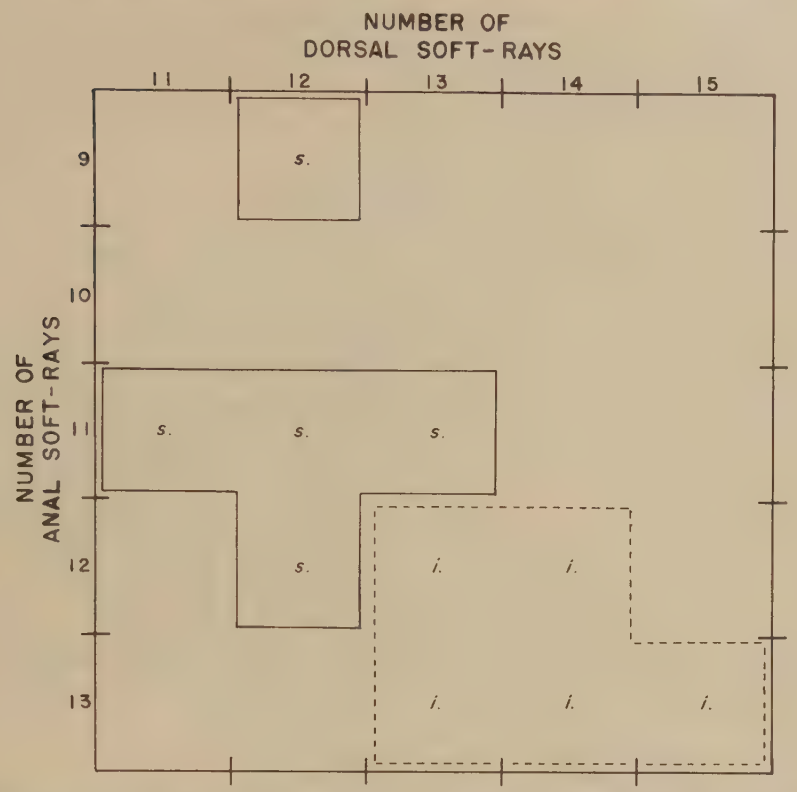

FIGURE 20.—Comparison of number of dorsal and anal soft-rays on 214 specimens of *Kyphosus* from the North Atlantic Ocean. Solid lines, enclosing *s.*'s, denote *K. sectatrix;* dashed lines, enclosing *i.*'s, denote *K. incisor.*

geographical ranges of both species, but distinct within much of the region intensively studied. In *K. sectatrix* 70 percent had 18 rays, 23 percent had 19 rays; in *K. incisor* 82 percent had 19 rays. Eighty-four percent of the specimens of *K. sectatrix* taken at Bermuda, the Bahamas, and in the Antilles Current had 19 rays, the normal count for *K. incisor;* 83 percent of those taken along the Atlantic coast of the United States had 18 rays (table 4). This indicates a population of *K. sectatrix,* in the Bahama-Bermuda region, distinct from the population found along the Atlantic coast of the United States. Soft-rays start branching in *K. sectatrix* by 15.4 mm. (in 8 rays); in *K. incisor* branching begins after 15.8 mm.

Pelvic fin.—No interspecific or intraspecific variations in the pelvic fin were observed.

Caudal fin.—No interspecific or intraspecific variations were observed in the principal caudal rays. In the dorsal lobe of the caudal fin, two *K. sectatrix* longer than 15 mm. had 9 secondary rays; two *K. incisor* more than 15 mm. had 10 secondary rays. Since secondary rays were counted only on six cleared and stained specimens (4 longer than 15 mm.), the value of this character for distinguishing the two species is questionable.

Gill rakers.—Numbers of first-arch gill rakers were good characters for separating *K. sectatrix* from *K. incisor* (fig. 21). On the entire first arch of specimens more than 16 mm., 96 percent of the *K. sectatrix* had 22 to 25 gill rakers, while 90 percent of the *K. incisor* had 26 to 31 gill rakers. On the upper limb of first arch of specimens above 16 mm., 67 percent of the *K. sectatrix* had 6 gill rakers, and 29 percent had 7 gill rakers; 19 percent of the *K. incisor* had 6 gill rakers and 80 percent had 7 or 8 gill rakers. On the lower limb of first arch of specimens above 16 mm., 92 percent of the *K. sectatrix* had 17 or 18 gill rakers; 75 percent of the *K. incisor* had 20 or 21 gill rakers. On the ceratobranchial bone, including all sizes, 91 percent of the *K. sectatrix* had 12 or 13 gill rakers; 95 percent of the *K. incisor* had 14 or 15 gill rakers.

Scales.—Interspecific variation in number of scales was indistinct throughout the geographical ranges of both species, but distinct within much

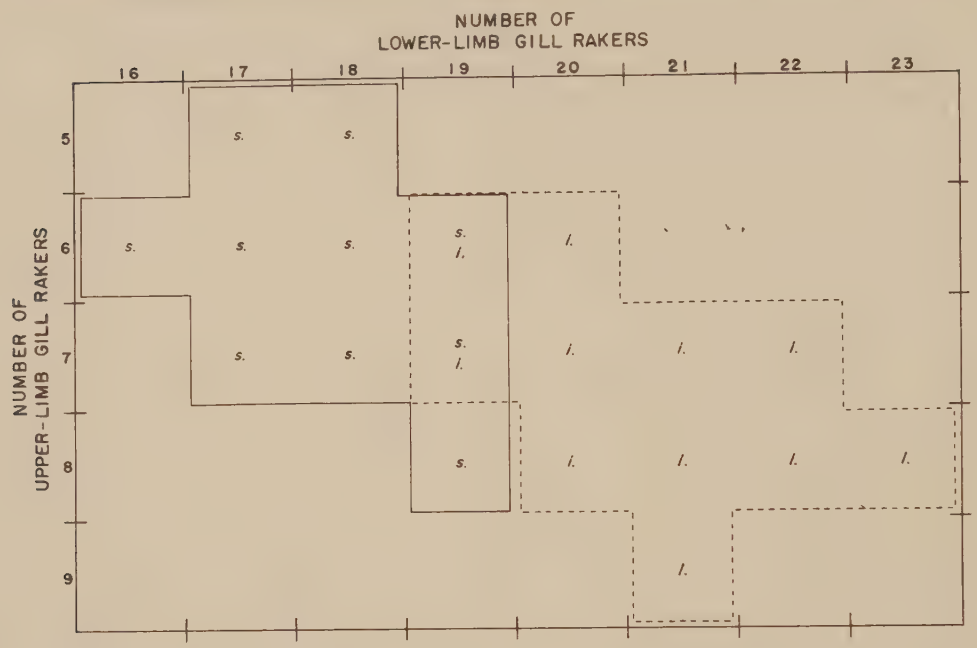

FIGURE 21.—Comparison of number of upper-limb and lower-limb gill rakers on the first arch of 165 specimens of *Kyphosus*, larger than 16 mm., from the North Atlantic Ocean. Solid lines, enclosing *s.*'s, denote *K. sectatrix;* dashed lines, enclosing *i.*'s, denote *K. incisor.*

of the region intensively studied. All specimens of *K. sectatrix* taken at Bermuda, the Bahamas, and in the Antilles Current had about the same number of scales (56 to 64), *K. incisor* has (54 to 62), counted in a straight line. All but one *K. sectatrix* taken along the Atlantic coast of the United States fell within a lower range (47 to 56) (table 7). The seven *K. sectatrix* taken in the Caribbean Sea had intermediate scale counts (54 to 58). As with pectoral fin rays, the straight-line scale counts indicate a distinct population of *K. sectatrix* in the Bahama-Bermuda region.

Teeth.—No interspecific variation in number of teeth on the premaxillary and dentary bones was observed.

Pigmentation.—The color patterns observed indicate that the ability to change pattern quickly, from bars to patches, observed by Townsend (1929) in *K. sectatrix*, is equally present in *K. incisor*. No comparison was made of fresh adult specimens. During development the color patterns are similar, except that most *K. incisor* from about 12 to 22 mm. have few or no pigment spots in the area of the first three dorsal and anal soft-rays, and few dark spots and lines on the pectorals (figs. 8, 9 A, B, and C); most *K. sectatrix* longer than 12 mm. have much heavier pigment on these parts (figs. 2 and 3A).

Caudal osteology.—No interspecific or intraspecific variations in caudal osteology were observed. A representative caudal base is illustrated in figure 22.

Branchiostegals.—Both species normally have seven branchiostegals on each side. However, one specimen of *K. incisor* had eight on one side and in this instance the first two were much closer together.

BODY PROPORTIONS

A slight indication of interspecific variation in eye diameter appeared only among specimens above 150 mm. (fig. 12). The eye diameters of all 18 *K. sectatrix* more than 150 mm. were 8.2 percent or more of standard length, except one specimen from Madeira (7.5 percent); those of the five *K. incisor* above 150 mm. long were 8.4 percent or less of standard length (table 13).

An indication of interspecific variation in head length, body depth at pelvic fin, and pectoral fin length appeared only among specimens more than 150 mm. from along the Atlantic coast of the

FIGURE 22.—Caudal skeleton of a 28.4-mm. *Kyphosus incisor*. (Camera lucida drawing from a cleared and stained specimen.)

United States and the northern Bahamas (figs. 13, 4, and 19). The three body proportions of these pecimens, seven *K. sectatrix* and four *K. incisor*, xpressed as percentage of standard length, howed the following: the head lengths of *K. ectatrix* were more than 27 percent, while those of *K. incisor* were less than 27.5 percent; the body epths at pelvic fin of *K. sectatrix* were 41 percent r more, while those of *K. incisor* were 41 percent r less; and the pectoral fin lengths of *K. sectatrix* ere above 18 percent, while those of *K. incisor* ere less than 18 percent (table 13).

There was little or no indication, at any size, of nterspecific variation in the distances from snout o dorsal, anal, pectoral, and pelvic fins (figs. 15, 6, 17, and 18).

TABLE 13.—*Measurements of selected body parts of 115 specimens of* Kyphosus sectatrix *and 99 specimens of* Kyphosus incisor, *expressed as percentage of standard length*

KYPHOSUS SECTATRIX

Standard length (mm.)	Percent of standard length							
	Eye diameter	Head length	Depth at pelvic fin	Snout to dorsal fin	Snout to anal fin	Snout to pectoral fin	Snout to pelvic fin	Pectoral fin length
10.4 [1]	13.3	36.2	35.5	49.0	65.4	35.5	42.9	22.6
10.5 [1]	14.9	38.3	34.6	47.6	65.7	34.6	44.8	23.0
10.5 [1]	14.2	37.8	35.1	48.6	61.9	34.0	43.0	21.5
11.3	14.0	35.6	34.8	46.9	65.5	32.7	41.6	22.2
11.3	13.4	36.9	35.8	48.7	65.5	34.8	42.7	21.4
12.0 [1]	13.5	34.8	39.2	49.2	65.0	34.2	43.2	24.1
12.7	13.9	36.1	35.6	48.0	61.4	34.6	40.9	23.1
13.1	14.6	37.1	35.4	49.6	66.4	34.5	44.3	20.9
13.2	13.9	35.4	38.6	47.0	62.9	32.4	42.4	22.2
15.0	14.4	35.3	40.7	46.7	65.3	32.1	42.7	21.0
15.4	13.9	36.4	39.0	44.8	66.2	31.3	41.6	22.4

See footnotes at end of table.

TABLE 13.—*Measurements of selected body parts of 115 specimens of* Kyphosus sectatrix *and 99 specimens of* Kyphosus incisor, *expressed as percentage of standard length*—Continued

KYPHOSUS SECTATRIX—Continued

Standard length (mm.)	Percent of standard length							
	Eye diameter	Head length	Depth at pelvic fin	Snout to dorsal fin	Snout to anal fin	Snout to pectoral fin	Snout to pelvic fin	Pectoral fin length
18.4	14.9	36.4	39.7	46.2	64.1	32.6	41.8	22.3
18.7	12.1	34.2	39.0	44.4	68.4	32.1	45.5	20.4
19.4 [1]	13.4	34.0	40.2	47.4	66.0	32.0	42.3	23.7
20.0 [1]	15.5	36.5	42.5	48.0	66.0	32.0	43.5	-------
21.5	12.3	34.0	38.6	42.8	68.8	33.5	47.4	21.3
22.5	13.8	35.1	43.1	47.6	65.8	32.0	41.3	22.7
22.9 [1]	14.4	35.8	41.9	47.2	65.5	33.6	44.1	24.0
25.6	14.5	37.9	41.8	47.7	66.0	32.4	43.0	23.0
26.1	12.6	37.5	41.0	46.4	65.1	35.2	45.6	21.5
26.4 [1]	12.8	33.7	41.3	47.0	64.8	31.8	42.4	23.1
26.8	12.6	35.4	44.0	45.5	63.4	32.1	42.9	22.0
26.9 [1]	13.3	35.3	40.5	46.5	66.2	30.9	42.4	21.9
28.5	11.8	34.0	41.0	46.3	66.3	32.3	44.9	22.5
29.1	14.4	36.1	41.2	46.0	62.5	33.7	42.6	22.0
29.9	14.7	35.5	43.5	45.5	62.9	33.8	40.1	22.7
30.8 [1]	12.3	34.7	39.6	43.8	65.9	32.5	40.6	21.8
33.3	11.4	32.7	45.0	45.3	64.3	30.3	42.0	20.7
33.9	12.7	35.4	42.2	44.8	63.7	31.3	40.7	-------
34.0	13.2	33.2	40.3	45.3	64.1	30.6	41.2	24.1
34.0 [1]	13.2	34.1	42.9	45.3	62.9	31.8	42.9	22.6
34.4	11.6	34.9	41.0	43.6	68.6	35.8	40.7	22.1
34.6	12.4	36.7	42.2	44.8	65.9	36.1	43.9	22.8
34.7 [1]	13.4	34.0	41.8	45.8	68.3	33.4	46.7	21.0
35.1	12.2	35.6	41.0	42.7	66.7	36.8	45.6	-------
36.1	11.6	34.3	45.1	45.1	63.2	32.4	42.4	20.5
36.2 [1]	12.5	32.6	40.9	46.4	65.2	29.8	42.5	22.4
36.4	12.6	33.8	40.9	44.8	61.3	30.2	42.0	22.5
36.6	12.6	35.2	41.8	46.2	65.0	32.8	42.6	22.7
36.9	10.8	35.2	42.0	41.5	66.7	34.7	45.0	-------
37.1	10.8	35.0	41.8	43.4	66.3	34.5	45.6	-------
37.3	11.3	34.9	42.6	42.1	67.6	35.9	47.7	22.3
37.4	13.1	35.3	43.8	45.7	64.4	32.1	40.9	23.3
37.5	12.0	34.7	42.1	44.8	62.4	32.3	42.4	21.9
37.6	12.5	35.4	41.5	41.8	67.3	33.8	47.3	23.4
37.9	12.1	33.0	40.4	43.5	62.3	31.1	41.2	22.4
38.2	11.3	35.1	40.8	43.2	68.1	35.6	47.1	-------
38.5	11.9	34.8	42.6	42.6	66.2	35.1	44.4	21.3
39.0	11.8	32.3	41.3	41.8	67.9	33.8	44.9	-------
39.2	11.7	34.7	42.6	41.8	67.3	34.7	48.2	23.2
39.3	12 0	33.8	42.7	41.7	64.9	34.4	43.3	-------
39.4	13.2	34.8	42.6	45.2	63.7	31.2	41.9	-------
39.6	12.4	32.6	41.4	43.9	61.9	30.6	40.9	22.0
39.6	12.6	36.4	45.5	45.5	63.1	31.8	41.7	23.2
40.0	11.0	34.5	42.2	41.2	68.0	33.7	47.2	23.2
40.3	11.9	34.7	42.7	43.9	61.8	32.3	41.7	21.8
40.4	11.4	34.4	42.8	41.1	68.1	32.2	45.8	21.3
40.6	11.8	34.5	42.6	41.9	64.3	34.7	42.6	-------
40.9	12.2	33.5	42.3	44.0	63.8	31.1	40.8	-------
41.1	11.7	33.8	41.8	42.3	67.6	34.1	47.2	21.2
41.2	12.4	34.5	43.0	44.2	62.9	31.1	41.7	22.3
41.6	11.8	33.7	42.3	43.3	63.7	31.7	39.4	-------
41.8	12.2	34.4	41.4	43.1	67.0	34.4	46.6	20.8
42.0	12.1	34.5	44.0	44.0	63.8	31.0	42.1	21.9
42.3	12.1	35.0	44.7	44.9	63.4	32.2	42.1	21.7
42.7	11.7	34.2	43.8	41.7	66.0	34.7	46.1	21.8
42.9	11.4	35.0	43.1	42.0	67.6	35.0	46.2	-------
43.3	11.3	33.5	43.2	44.3	67.0	33.7	46.0	21.7
44.0	11.4	33.6	45.2	43.6	65.0	31.4	41.8	22.7
44.0	11.8	35.2	42.7	42.7	67.0	36.4	46.6	-------
44.9	11.6	33.2	43.7	43.7	62.8	30.7	42.1	22.5
45.0	12.2	34.7	43.3	45.1	62.2	31.1	41.8	22.0
45.1	12.2	34.6	43.2	45.7	62.3	31.5	41.0	22.4
45.3	11.0	33.6	42.2	41.7	66.2	32.7	47.0	21.9
45.5	10.8	33.4	40.9	42.6	65.5	34.3	44.6	21.5
45.6	10.7	31.8	42.5	42.8	64.5	34.4	46.7	21.3
45.7	12.0	32.8	44.0	44.2	63.0	30.4	41.1	21.7
46.5 [2]	12.7	33.5	44.3	44.7	63.7	31.0	43.2	23.7
47.1	11.7	34.2	42.7	43.9	62.8	31.2	42.0	-------
47.3	10.8	33.2	42.5	41.2	62.4	33.8	41.2	22.6
47.5	11.2	35.4	44.4	44.8	63.4	31.8	43.2	22.7
47.8	12.6	34.7	42.7	44.3	62.8	31.0	40.6	22.4
47.8	11.5	33.1	43.3	43.1	64.4	32.0	40.4	21.1
47.9	11.3	33.4	43.0	43.8	62.8	29.6	39.5	22.3
48.7	11.1	33.7	43.3	42.7	64.3	31.8	41.3	21.4
52.0	11.9	34.4	44.8	44.6	65.4	31.5	43.1	23.3
52.0	11.5	34.2	41.9	42.1	61.2	30.2	41.2	22.5
55.0	12.0	34.5	44.2	45.5	62.7	31.6	42.2	22.9
55.0	10.9	33.5	42.7	42.7	62.0	31.8	41.5	22.2
71.5	9.6	31.3	42.2	43.1	61.5	28.5	38.2	19.7
77.5	10.3	31.4	46.1	43.6	62.6	28.4	38.7	20.0

See footnotes at end of table.

TABLE 13.—*Measurements of selected body parts of 1[illegible] specimens of* Kyphosus sectatrix *and 99 specimens* Kyphosus incisor, *expressed as percentage of standa[illegible] length*—Continued

KYPHOSUS SECTATRIX—Continued

Standard length (mm.)	Percent of standard length							
	Eye diameter	Head length	Depth at pelvic fin	Snout to dorsal fin	Snout to anal fin	Snout to pectoral fin	Snout to pelvic fin	Pec tor fin leng
99.5	12.0	33.9	47.7	46.5	66.3	31.2	41.2	2[illegible]
100.5 [2]	9.0	28.0	41.0	41.0	62.2	26.7	36.9	1[illegible]
104.5 [1]	8.9	28.3	40.5	40.2	60.3	27.3	37.6	2[illegible]
115.0	10.2	30.0	45.7	45.2	60.9	26.6	35.8	1[illegible]
125.0	11.1	32.0	46.6	46.2	66.7	29.8	41.1	1[illegible]
133.0	8.3	28.6	42.5	42.1	64.4	27.7	39.5	1[illegible]
154.5 [2]	9.9	27.8	40.5	41.7	66.3	27.2	39.2	1[illegible]
157.5	10.2	30.0	44.4	44.8	65.1	27.0	37.9	18
168.5 [2]	9.7	27.7	41.8	43.1	63.8	26.9	35.9	1[illegible]
171.0 [2]	9.7	27.5	43.3	42.0	63.7	26.5	37.7	18
172.5 [1]	8.7	28.2	42.6	42.0	68.1	28.7	41.2	1[illegible]
181.5 [1]	9.3	28.7	43.5	42.7	65.6	27.5	38.6	1[illegible]
186.5	9.5	29.5	45.6	45.4	62.2	26.5	37.3	1[illegible]
194.0 [2]	8.6	25.5	39.7	40.0	60.6	25.8	36.1	18
211.0 [2]	7.5	26.8	43.1	40.3	64.0	27.5	39.3	17
211.0	9.6	29.4	42.9	43.8	65.9	28.7	39.1	19
212.0 [2]	8.7	28.3	42.7	42.5	64.6	27.4	38.2	17
215.5 [1]	8.4	27.1	41.0	41.3	64.3	27.3	39.1	18
219.0 [2]	9.2	27.9	41.9	42.7	63.2	25.8	36.3	18
230.0 [2]	8.8	27.6	39.6	42.6	64.1	27.8	36.7	19
236.5 [2]	8.2	26.8	44.4	42.9	65.1	27.3	38.1	19
244.0 [2]	8.3	29.1	46.7	44.9	64.5	26.0	37.1	18
259.0 [2]	8.2	27.6	39.6	41.7	61.8	26.8	37.1	18
260.0	8.2	29.0	43.5	43.8	67.7	27.5	38.8	19

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8.5	16.5	38.8	32.9	50.6	67.1	37.6	45.9	20
8.7	14.4	35.1	31.8	46.6	60.9	32.5	40.3	20
9.1	13.7	35.2	33.5	46.4	64.8	33.5	43.3	-----
9.8	13.3	34.6	32.4	46.1	62.2	34.7	40.7	-----
10.0	14.5	36.5	34.5	47.6	62.0	33.9	40.5	20
10.2	13.1	35.4	34.4	48.4	61.8	34.4	42.0	19
10.3	14.6	36.9	35.9	46.6	64.1	40.0	42.7	22
11.4	13.2	33.3	35.1	46.5	63.2	33.3	40.4	19
11.9	12.6	35.3	36.1	45.4	62.2	34.5	42.0	21
12.1	13.7	35.2	37.4	47.9	62.0	34.9	42.1	20
12.5	14.2	35.9	38.1	48.0	60.8	35.2	40.8	22
12.7 [1]	13.9	34.9	37.0	47.2	61.4	34.2	42.5	20
12.8	13.8	35.8	36.7	47.7	61.7	33.0	40.6	18
13.1	13.7	34.4	35.1	45.0	61.1	32.1	42.0	19
13.2	13.6	34.8	38.6	44.7	64.4	32.6	42.4	22
13.5	13.4	33.3	36.1	47.4	63.7	31.3	42.2	19
13.6	13.0	34.6	37.5	47.1	61.8	32.4	41.9	21
13.7	13.4	34.7	38.7	47.4	62.0	32.6	40.9	22
14.2	13.5	35.1	37.3	46.5	62.7	31.8	43.0	21
14.3	13.6	36.4	38.5	46.8	67.8	35.0	43.4	20
14.3	14.3	36.4	36.4	47.6	63.6	34.1	42.7	22
14.3	12.5	35.7	33.7	44.8	62.2	35.0	42.0	19
14.5	14.1	36.6	39.3	46.9	62.8	35.2	42.1	21
14.5	13.8	35.2	40.0	49.0	62.1	33.8	41.4	-----
14.7	13.6	36.1	38.8	45.6	62.6	34.0	42.2	22
14.7 [1]	13.7	35.4	36.7	47.6	67.3	33.2	41.5	20
15.5	13.9	36.1	37.4	46.5	62.6	32.9	43.5	22
15.8	12.6	33.5	34.8	45.6	63.9	32.9	41.8	-----
16.1	14.3	37.3	38.5	44.7	65.8	36.0	46.0	23
16.2	13.7	36.4	40.1	44.4	63.0	33.3	43.2	22
16.4	14.1	36.0	37.8	46.3	63.4	31.7	43.3	21
16.7	13.5	34.7	37.7	45.5	65.9	31.7	43.1	22
17.2	14.1	36.0	37.2	45.3	65.1	34.3	46.5	20
17.3	15.0	37.6	41.6	47.4	64.2	34.1	44.5	23
17.5	13.3	34.3	37.7	44.0	65.1	32.6	43.4	20
17.6	13.9	36.4	35.8	44.9	63.6	34.1	45.5	19
18.2	14.2	35.7	40.7	46.2	63.7	33.4	42.3	21
18.6	13.7	35.5	39.8	44.6	68.3	33.3	48.4	20
19.0	12.9	35.8	36.8	44.7	66.3	34.2	44.2	20
19.2 [1]	15.2	36.9	34.9	46.3	63.5	34.9	44.2	23
19.9	15.6	38.7	42.2	46.7	66.3	34.7	46.2	21
21.2	13.7	34.9	38.7	47.2	63.7	33.0	43.4	20
21.7	12.4	34.1	39.6	46.5	65.0	31.3	42.4	19
22.0	12.0	32.7	37.3	43.6	66.8	33.6	46.4	21
23.3	12.8	34.8	42.5	45.1	64.4	33.0	43.3	20
23.4	12.4	33.8	39.7	46.6	62.8	30.8	41.5	23
23.5	14.0	34.0	37.0	46.8	64.7	32.3	41.3	22
23.9	13.8	33.9	39.7	46.9	61.5	30.5	41.0	21
24.2	11.9	33.9	38.8	43.4	65.7	32.2	46.7	19
24.4	14.8	37.3	37.7	45.9	-------	35.7	43.0	22
24.7	13.3	34.0	42.5	-------	66.0	32.8	43.3	21

TABLE 13.—*Measurements of selected body parts of 115 specimens of* Kyphosus sectatrix *and 99 specimens of* Kyphosus incisor, *expressed as percentage of standard length*—Continued

KYPHOSUS INCISOR—Continued

Standard length (mm.)	Percent of standard length							
	Eye diameter	Head length	Depth at pelvic fin	Snout to dorsal fin	Snout to anal fin	Snout to pectoral fin	Snout to pelvic fin	Pectoral fin length
4.8	14.1	36.7	39.1	44.0	68.1	33.9	48.0	23.4
5.4	12.6	35.4	40.2	44.1	63.8	33.9	44.9	20.9
5.4	11.4	33.9	35.4	44.9	61.0	33.9	43.3	20.5
5.5	12.9	32.9	40.4	47.5	63.5	32.5	43.1	23.5
5.8	13.2	35.7	39.5	45.0	64.0	33.7	44.6	22.1
6.3	13.3	33.1	40.7	44.5	66.2	33.5	45.2	22.0
7.4	11.5	32.8	38.3	44.5	65.7	31.7	43.1	19.7
7.5	12.7	33.5	41.8	45.1	63.6	30.2	40.4	22.5
7.7	13.0	35.0	42.2	43.7	65.7	34.7	45.1	22.4
8.0	12.9	36.4	43.6	43.9	61.4	31.8	41.4	21.1
8.4	11.2	31.7	43.3	44.0	64.8	30.6	42.6	21.8
8.6	14.0	36.0	40.6	47.2	64.0	32.5	43.4	21.7
8.6	11.9	31.8	40.9	44.1	63.3	28.7	40.9	22.7
9.6	11.8	33.4	38.9	42.9	64.9	34.1	42.9	22.0
9.7	12.4	33.7	40.1	46.5	62.0	31.0	42.4	19.9
9.8	12.4	34.2	38.9	43.0	63.4	33.6	42.3	23.8
10.8	11.7	31.8	40.9	44.5	61.4	30.2	39.6	23.1
11.0	11.9	31.3	41.6	42.3	62.9	30.0	39.7	21.6
12.5	12.9	32.6	39.4	45.5	61.5	30.8	41.5	22.1
13.6	11.9	32.4	43.7	46.4	64.0	29.8	42.0	20.8
14.5	12.6	33.9	43.5	47.5	62.6	31.0	42.6	22.3
15.1	12.8	34.8	42.2	45.6	61.8	32.8	41.9	21.7
15.2	13.1	34.1	41.5	44.9	61.6	31.5	41.5	23.0
17.0	11.9	33.8	41.6	45.1	63.5	31.6	42.4	21.9
17.5	11.6	31.7	40.3	44.5	63.2	30.4	42.1	21.3
17.5	12.3	31.5	42.1	45.9	59.7	29.9	40.5	22.1
18.0	11.8	33.2	38.4	43.9	61.1	30.5	39.5	21.3
18.2	11.0	32.5	40.8	-------	64.7	33.0	46.9	22.3
18.3	11.5	32.1	41.5	44.6	61.9	29.2	41.0	21.1
18.7	12.7	34.4	39.5	42.1	61.5	34.6	42.6	-------
18.8	12.4	34.8	41.0	45.1	62.6	32.2	44.3	21.1
19.1	12.3	35.0	44.8	43.7	63.4	32.2	42.2	21.5
21.5	11.3	35.7	44.1	44.1	64.3	30.4	42.4	22.2
24.2	12.4	33.9	41.6	45.5	62.2	30.8	40.5	22.4
24.5	11.5	33.3	43.6	43.1	62.2	30.3	41.8	22.2
24.5	11.7	33.0	38.9	40.9	64.5	32.8	46.3	22.5
25.2	10.8	33.6	43.4	43.4	63.7	30.3	42.7	21.9
25.2	11.9	32.1	41.4	42.0	61.3	29.0	39.4	22.1
25.5	11.2	36.0	44.4	44.2	63.7	30.5	41.5	21.5
30.0	10.4	32.4	41.6	44.6	63.8	32.4	45.2	20.4
34.5 [1]	11.7	33.3	41.5	45.0	62.8	30.6	42.2	22.6
38.5	10.9	32.1	42.1	41.9	63.2	29.4	39.3	21.7
101.5	8.9	28.9	41.9	42.8	58.0	27.1	38.4	20.9
84.5	7.7	26.0	39.8	38.8	60.7	25.5	36.3	17.5
92.0	8.2	26.3	40.4	41.7	62.5	26.0	37.0	17.7
33.0 [2]	8.4	28.1	40.8	42.9	61.4	25.5	35.2	18.2
39.0	6.9	25.7	41.0	39.1	63.0	24.5	35.8	16.9
52.0 [2]	7.9	27.4	40.3	39.9	64.1	27.4	39.9	17.3

[1] Specimens from northern Bahamas (including Antilles Current and excluding Florida Current.
[2] Specimens captured beyond the Atlantic coast of the United States and the northern Bahamas.

KEY TO THE NORTH ATLANTIC SPECIES OF *KYPHOSUS*

This key is designed for specimens larger than about 16 mm., approximately the size at which gill rakers are sufficiently formed to be used in separation (fig. 21). The dorsal and anal soft-rays may be used in separation of specimens as small as 8.5 mm. (fig. 20).

A. Total dorsal and anal soft-rays, 23 or 24 (rarely 21 or 22). Dorsal rays, 12 (rarely 11 or 13). Anal rays, 11 (rarely 9 or 12). Gill rakers on first arch; lower limb, 17 or 18 (rarely 16 or 19); entire arch, 22 to 26 (rarely 27); ceratobranchial bone, 12 or 13 (rarely 11) under 150 mm. and 13 or 14 over 150 mm.
Kyphosus sectatrix (Linnaeus).

B. Total dorsal and anal soft-rays, 25 to 27 (rarely 28). Dorsal rays, 13 or 14 (rarely 15). Anal rays 12 or 13. Gill rakers on first arch; lower limb, 19 to 22 (rarely 23); entire arch, 25 to 30 (rarely 31); ceratobranchial bone, 14 or 15 (rarely 13) under 150 mm. and 15 over 150 mm.
Kyphosus incisor (Cuvier).

DISTRIBUTION ALONG THE ATLANTIC COAST OF UNITED STATES AND NORTHERN BAHAMAS

The extension of records of *K. incisor* north to Cape Cod makes the northern known range in the western North Atlantic the same for both *K. sectatrix* and *K. incisor*. Juveniles of both species were frequently caught under the same patch of *Sargassum;* however, Longley and Hildebrand (1941) reported the adults of *K. sectatrix* and *K. incisor* to school around different coral reefs at Tortugas, Fla.

There is little apparent difference in the length of spawning season. In the Bahamas, 8 *K. sectatrix* less than 40 mm. were taken in the winter; the only specimens of *K. incisor* less than 40 mm. were taken in the summer (figs. 5 and 11).

LITERATURE CITED

ANDERSON, WILLIAM W.
1957. Early development, spawning, growth, and occurrence of the silver mullet (*Mugil curema*) along the south Atlantic coast of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Fishery Bulletin, No. 119, vol. 57, p. 397–414.

ANDERSON, WILLIAM W., and JACK W. GEHRINGER.
1957a. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States *Theodore N. Gill* cruise 3. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 210. 208 p.
1957b. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States M/V *Theodore N. Gill* cruise 4. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 234. 192 p.
1958a. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States M/V *Theodore N. Gill* cruise 5. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 248. 220 p.
1958b. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States

M/V *Theodore N. Gill* cruise 6. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 265. 99 p.

1959a. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States M/V *Theodore N. Gill* cruise 7. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 278. 277 p.

1959b. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States M/V *Theodore N. Gill* cruise 8. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 303. 227 p.

1959c. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States M/V *Theodore N. Gill* cruise 9. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 313. 226 p.

ANDERSON, WILLIAM W., JACK W. GEHRINGER, and EDWARD COHEN.

1956a. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States M/V *Theodore N. Gill* cruise 1. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 178. 160 p.

1956b. Physical oceanographic, biological, and chemical data south Atlantic coast of the United States *Theodore N. Gill* cruise 2. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 198. 270 p.

BAIRD, S[PENCER] F.

1873. List of fishes collected at Woods Hole. U.S. Commission of Fish and Fisheries. Part 1. Report on the condition of the sea fisheries of the south coast of New England in 1871 and 1872. p. 823–827.

BEAN, BARTON A.

1905. Fishes of the Bahama Islands. In The Bahama Islands. Geographical Society of Baltimore, Johns Hopkins Press, p. 293–325.

BEAN, TARLETON H.

1897. Notes upon New York fishes received at the New York aquarium, 1895–1897. American Museum of Natural History, Bulletin 9, article 24, p. 327–375.

1903. Catalogue of the fishes of New York. New York State Museum, No. 60, Zoology 9. 784 p.

BOWDICH, [SARAH].

1825. III Appendix: Containing zoological and botanical descriptions, and translations from the arabic. Fishes of the Gambia, p. 233–238. In Bowdich, T[homas] Edward. 1825. Excursions in Madeira and Porto Santo during the Autumn of 1823, while on his third voyage to Africa. George B. Whittaker, London.

CARVALHO, J. PAIVA.

1950. Resultados cientificos do cruzeiro do "Baependi" e do "Vega" a l. da Trindade (Peixes). Boletim do Instituto Paulista de Oceanografia, Sao Paulo, Brasil. Vol. 1, no. 1, p. 97–133. [In Brazilian Portuguese with English summary.]

CATESBY, MARK.

1743. The natural history of Carolina, Florida, an the Bahama Islands: containing the figures of bird beasts, fishes, serpents, insects and plants, etc. Vo 2, 1st edition, London. 31 p.

CUVIER, [GEORGES], and [ACHILLE] VALENCIENNES.

1831. Histoire naturelle des poissons. Vol. 7, F. C Levrault, Paris. 531 p.

DODERLEIN, P[IETRO].

1884. Rinvenimento di una specie di pesce del esotico genere *Pimelepterus* Lac. nelle acque d golfo di Palermo. Il Naturalista Siciliano, Giornal di Scienze Naturali. Third Year, (1883–84), Virz Palermo, p. 81–86.

EVANS, HOWARD E.

1948. Cleaning and staining small invertebrates, i toto, for demonstrating ossification. Turtox News Vol. 26, no. 2, p. 42–47.

EVERMANN, BARTON WARREN, and WILLIAM CONVERS KENDALL.

1900. Check-list of the fishes of Florida. U.S. Com mission of Fish and Fisheries. Part 25. Repor of the Commissioner for the year, ending June 30 1899, p. 37–103.

EVERMANN, BARTON WARREN, and MILLARD CALE MARSH.

1900. The fishes of Porto Rico. U.S. Fish Commis sion, Bulletin, vol. 20, Part 1, p. 49–350.

FOWLER, HENRY W.

1915. Cold-blooded vertebrates from Florida, th West Indies, Costa Rica, and eastern Brazil Academy of Natural Sciences of Philadelphia Proceedings, p. 244–269.

1917. Notes on New England fishes. Boston Society of Natural History, Proceedings, 1914–20 vol. 35, no. 4, p. 109–138.

1929. Notes on percoid and related fishes. Academy of Natural Sciences of Philadelphia, Proceedings vol. 81, p. 633–657.

1944. The fishes. Results of the fifth George Vanderbilt expedition (1941). (Bahamas, Carib bean Sea, Panama, Galapagos Archipelago and Mexican Pacific islands). Academy of Natura Sciences of Philadelphia, Monographs, No. 6, p 75–583.

1945. A study of the fishes of the southern peidmont and coastal plain. Academy of Natural Sciences of Philadelphia, Monographs, No. 7, 408 p.

1952. A list of the fishes of New Jersey, with off-shore species. Academy of Natural Sciences of Philadelphia, Proceedings, vol. 104, p. 89–151.

1953. The shore fishes of the Colombian Caribbean (Ictiologia). Instituto de Ciencias Naturales de la Universidad Nacional de Colombia—Bogota, Boletin, vol. 6, no. 27, Caldasia, p. 43–73.

GMELIN, JO[HANN] FRID[ERICK].

1789. Caroli a Linnè . . . Systema Naturae. Tomus primus, Editio decima tertia, aucta, reformata. Classis pisces, Lugbuni Apud J. B. Della-molliere, Pars III, p. 1126–1516.

GOODE, G[EORGE] BROWN.
1879. A preliminary catalogue of the fishes of the St. Johns River and the east coast of Florida. With descriptions of a new genus and three new species. U.S. National Museum, Proceedings, vol. 2, p. 108–121.

GÜNTHER, ALBERT.
1859. Catalogue of the acanthopterygian fishes in the collection of the British Museum. Gasterosteidae, Berycidae, Percidae, Aphredoderidae, Pristipomatidae, Mullidae, Sparidae. Vol. 1. 524 p.

HILDEBRAND, SAMUEL F., and WILLIAM C. SCHROEDER.
1928. Fishes of Chesapeake Bay. U.S. Bureau of Fisheries, Bulletin, vol. 43 (1927), part 1, Document 1024. 388 p.

HOLLISTER, GLORIA.
1934. Clearing and dyeing fish for bone study. New York Zoological Society, Zoologica, vol. 12, No. 10, p. 89–101.

JORDAN, DAVID S.
1884. List of fishes collected at Key West, Florida, with notes and descriptions. U.S. National Museum, Proceedings, vol. 7, p. 103–150.

JORDAN, DAVID STARR, and BARTON WARREN EVERMANN.
1898. The fishes of North and Middle America: A descriptive catalogue of the species of fishlike vertebrates found in the waters of North America, north of the Isthmus of Panama. U.S. National Museum, Bulletin No. 47. Part 2, p. 1241–2183.
1927. New genera and species of North American fishes. California Academy of Sciences, Proceedings, series 4, vol. 16, No. 15, p. 501–507.

JORDAN, DAVID STARR, BARTON WARREN EVERMANN, and HOWARD WALTON CLARK.
1930. Check list of the fishes and fishlike vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. U.S. Commissioner of Fisheries, Report for the fiscal year 1928. Part 2, appendix 10, Bureau of Fisheries, Document 1055. 670 p. [Reprinted.]

JORDAN, DAVID STARR, and BERT FESLER.
1893. A review of the sparoid fishes of America and Europe. U.S. Commission of Fish and Fisheries, Report of the Commissioner for 1889–1891, p. 421–544.

JORDAN, DAVID S., and CHARLES H. GILBERT.
1879. Notes on the fishes of Beaufort Harbor, N.C. U.S. National Museum, vol. 1(1878), p. 365–388.
1881. Notes on a collection of fishes, made by Lt. Henry E. Nichols, U.S.N., on the west coast of Mexico, with descriptions of new species. U.S. National Museum, Proceedings, vol. 4, p. 225–233.

JORDAN, D[AVID] S., and C[HARLES] H. GILBERT.
1883. On certain neglected generic names of Lacépède. U.S. National Museum, Proceedings, vol. 5(1882), p. 570–576.

JORDAN, DAVID STARR, and JOSEPH C. THOMPSON.
1905. The fish fauna of the Tortugas Archipelago. U.S. Bureau of Fisheries, Bulletin, vol. 24(1904), p. 231–256.

KENDALL, WILLIAM C.
1908. Fauna of New England. 8. List of the pisces. Boston Society of Natural History, Occasional Papers, No. 7. 152 p.

LACÉPÈDE, [BERNHARD G. E.].
1802. Histoire naturelle des poissons. Tome Troisième, Chez Plassan, Paris. 558 p.
1803. Histoire naturelle des poissons. Tome Quatrième, Chez Plassan, Paris. 728 p.

LEE, THOMAS.
1889. List of fishes taken by steamer *Albatross* among Bahama Islands and at Nassau fish-market during March and April 1886. U.S. Fish Commission Report, part 14(1886), p. 669–672.

LINNAEUS, CARL.
1758. Systema naturae. Editio decima, Reformata Tomus I, Laurentii Salvii, Holmiae. 824 p.
1766. Systema naturae. Editio duodecima, Reformata Tomus I, part 1, Laurentii Salvii, Stockholm. 532 p.

LONGLEY, WILLIAM H., and SAMUEL F. HILDEBRAND.
1941. Systematic catalogue of the fishes of Tortugas, Florida, with observations on color, habits, and local distribution. Carnegie Institution of Washington, publication 535, Tortugas Laboratory, Papers, vol. 34. 331 p.

MANSUETI, ROMEO [J.].
1958. The development of anal spines and soft-rays in young striped bass, *Roccus saxatilis*. Maryland Department of Research and Education, Contribution No. 113. 12 p.

MEEK, SETH E., and SAMUEL F. HILDEBRAND.
1925. The marine fishes of Panama. Field Museum of Natural History, Chicago, Publication 226, Zoological Series, vol. 15, part 2, p. 330–707.

METZELAAR, J.
1919. Report on the fishes, collected by Dr. J. Boeke in the Dutch West Indies, 1904–1905, with comparative notes on marine fishes of tropical west Africa. Rapport Betreffende een voorloopig onderzoek naar den toestand van de Visscherij en de Industrie van Zeeproducten in de Kolonie Curacao. 316 p.

MIRANDA RIBEIRO, A[LIPIO] DE.
1919. A fauna vertebrada da Ilha da Trindade. Archivos do Museu Nacional do Rio de Janeiro, vol. 22, p. 171–179. [In Brazilian Portuguese.]

MOWBRAY, LOUIS S.
1949. The commercial and game fishing industries of Bermuda. A paper prepared . . . for the Gulf and Caribbean Fisheries Institute held at Miami Beach, Florida, November, 1949. 19 p.

NICHOLS, J[OHN] T., and C[HARLES] M. BREDER, JR.
1927. The marine fishes of New York and southern New England. New York Zoological Society, Zoologica, vol. 9, No. 1. 192 p.

PARR, ALBERT EIDE.
1930. Teleostean shore and shallow-water fishes from the Bahamas and Turks Island. Bingham Oceano-

graphic Collection, Bulletin, Peabody Museum of Natural History, Yale University, vol. 3, article 4. 148 p.

POEY, FELIPE.
1866. Repertorio fisico—natural de la Isla de Cuba. Revista de los tipos Cuvierianos y Valenciennianos correspondientes a los peces de la Isla de Cuba. Havana, Tomo 1, p. 308–338.

ROSEN, NILS.
1911. Contributions to the fauna of the Bahamas. III. The Fishes. Lunds Universitets Arsskrift, Ny Foljd, afd. 2, bd. 7, nr. 5, p. 46–72.

SMITH, HUGH M.
1898. Fishes found in the vicinity of Woods Hole. U.S. Fish Commission, Bulletin, vol. 17 (1897), p. 85–111.
1907. The fishes of North Carolina. North Carolina Geological and Economic Survey, vol. 2. 453 p.

TORTONESE, ENRICO.
1954. Pesci rari e interessanti dei mari di Sicilia. Conserve e Derivati Agrumari, Palermo, vol. 3, No. 10, April–June, 1954, p. 79–83.

TOWNSEND, CHARLES HASKINS.
1929. Records of changes in color among fishes. New York Zoological Society, Zoologica, vol. 9, No, 9, p. 321–378.

TRUITT, REGINALD V., BARTON APPLER BEAN, and HENRY W. FOWLER.
1929. The fishes of Maryland. Maryland Conservation Bulletin, No. 3. 120 p.

U. S. DEPARTMENT of COMMERCE, COAST and GEODETIC SURVEY.
1955. Surface water temperatures at tide stations Atlantic Coast North and South America. Special Publication No. 278, 5th edition (with data through 1954), U.S. Department of Commerce, Coast and Geodetic Survey, Washington. 69 p.

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